

**2006 Buick Lucerne CXS**

2006 ENGINE Engine Cooling - Lucerne

**2006 ENGINE****Engine Cooling - Lucerne****SPECIFICATIONS****FASTENER TIGHTENING SPECIFICATIONS****Fastener Tightening Specifications**

<b>Application</b>	<b>Specification</b>	
	<b>Metric</b>	<b>English</b>
Air Conditioning (A/C) Condenser Bolt	13 N.m	115 lb in
Camshaft End Cap (RPO LD8)	2 N.m	18 lb in
Coolant Recovery Reservoir Nut (RPO L26)	9 N.m	80 lb in
Cooling Fan Motor Bolt	6 N.m	53 lb in
Cooling Fan Shroud Bolt	6 N.m	53 lb in
Cooling Fan Nut	6 N.m	53 lb in
Coolant Heater (RPO L26)	50 N.m	37 lb ft
Coolant Heater Bolt (RPO LD8)	10 N.m	89 lb in
Engine Coolant Outlet Fitting (RPO LD8)	47 N.m	35 lb ft
Evaporative Emission (EVAP) Canister Purge Solenoid Valve Bolt (RPO LD8)	10 N.m	89 lb in
Exhaust Gas Recirculation (EGR) Inlet Pipe Bolt (RPO LD8)	25 N.m	18 lb ft
Exhaust Gas Recirculation (EGR) Inlet Pipe Nut (RPO LD8)	60 N.m	44 lb ft
Exhaust Gas Recirculation (EGR) Valve Bolt (RPO LD8)	25 N.m	18 lb ft
Exhaust Gas Recirculation (EGR) Valve Shield Nut (RPO LD8)	10 N.m	89 lb in
Fuel Rail Bracket Nut (RPO LD8)	10 N.m	89 lb in
Manifold Absolute Pressure (MAP) Sensor Bracket Bolt (RPO LD8)	10 N.m	89 lb in
Oil Cooler Pipe Bolt	6 N.m	53 lb in
Oil Level Indicator Tube Nut (RPO LD8)	10 N.m	89 lb in
Power Steering Pump Bolt (RPO L26)	34 N.m	25 lb ft
Radiator Support Bracket Bolt	25 N.m	18 lb ft
Rear Left Lift Bracket Bolt (RPO LD8)	25 N.m	18 lb ft
Surge Tank Nut (RPO LD8)	9 N.m	80 lb in
Thermostat Housing Bolt (RPO L26)	25 N.m	18 lb ft

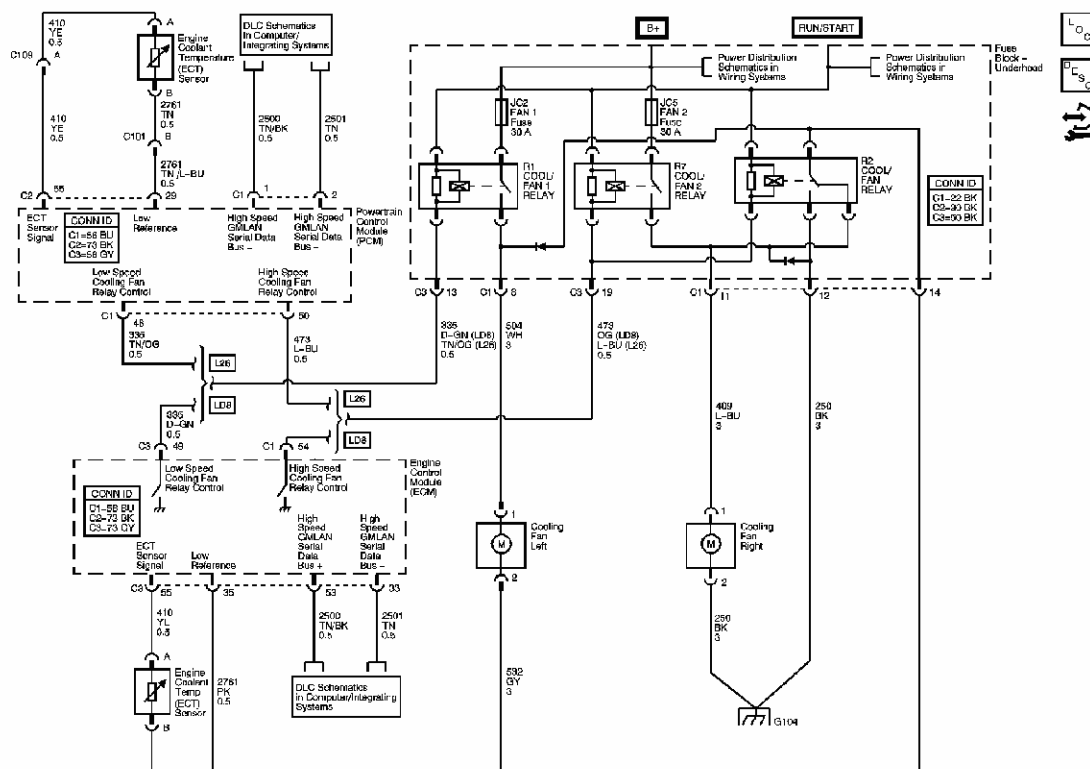
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Thermostat Housing Bolt (RPO LD8)	10 N.m	89 lb in
Thermostat Housing Bolt (RPO LD8)	10 N.m	89 lb in
Thermostat Housing Bolt (RPO LD8)	2.25 N.m	20 lb in
Transaxle Oil Cooler Pipe Bolt	6 N.m	53 lb in
Water Pump Bolt (RPO L26)	15 N.m	11 lb ft
Water Pump Bolt (RPO LD8)	10 N.m	89 lb in
Water Pump Cover Bolt/Stud (RPO LD8)	10 N.m	89 lb in
Water Pump Drive Belt Tensioner Shield Bolt/Nut (RPO LD8)	10 N.m	89 lb in
Water Pump Drive Belt Tensioner Stud (RPO LD8)	10 N.m	89 lb in
Water Pump Housing Bolt (RPO LD8)	25 N.m	18 lb ft
Water Pump Pulley Bolt (RPO L26)	13 N.m	115 lb in

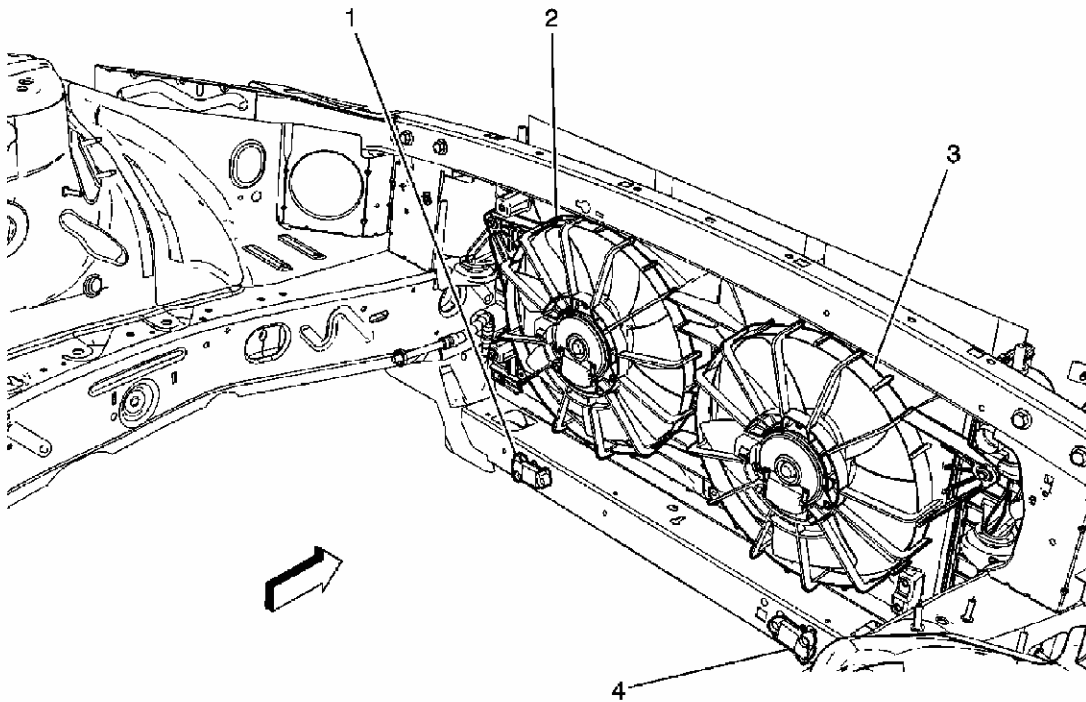
## SCHEMATIC AND ROUTING DIAGRAMS

### ENGINE COOLING SCHEMATICS



**Fig. 1: Engine Cooling Schematic**  
**Courtesy of GENERAL MOTORS CORP.**

## COMPONENT LOCATOR

**COOLING SYSTEM COMPONENT VIEWS**

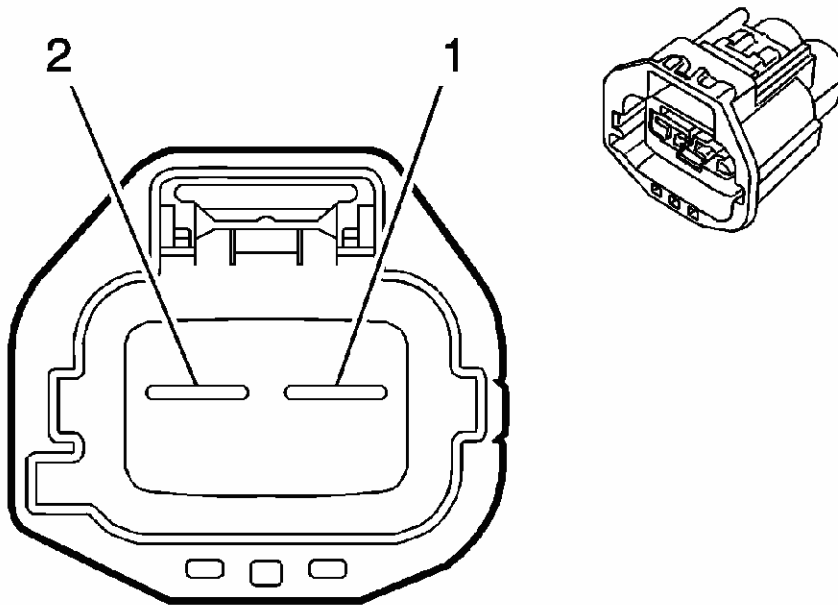
**Fig. 2: View Of Front Of The Engine Compartment**  
**Courtesy of GENERAL MOTORS CORP.**

**Callouts For Fig. 2**

Callout	Component Name
1	Inflatable Restraint Front End Sensor - Left
2	Cooling Fan - Left
3	Cooling Fan - Right
4	Inflatable Restraint Front End Sensor - Right

**COOLING SYSTEM CONNECTOR END VIEWS**

**Cooling Fan - Left**



**Fig. 3: Left Cooling Fan Connector End View**  
Courtesy of GENERAL MOTORS CORP.

### Cooling System Connector End Views

#### Connector Part Information

- OEM: 7283-5596-10
- Service: 88953307
- Description: 2-Way F 6.3 (GY)

#### Terminal Part Information

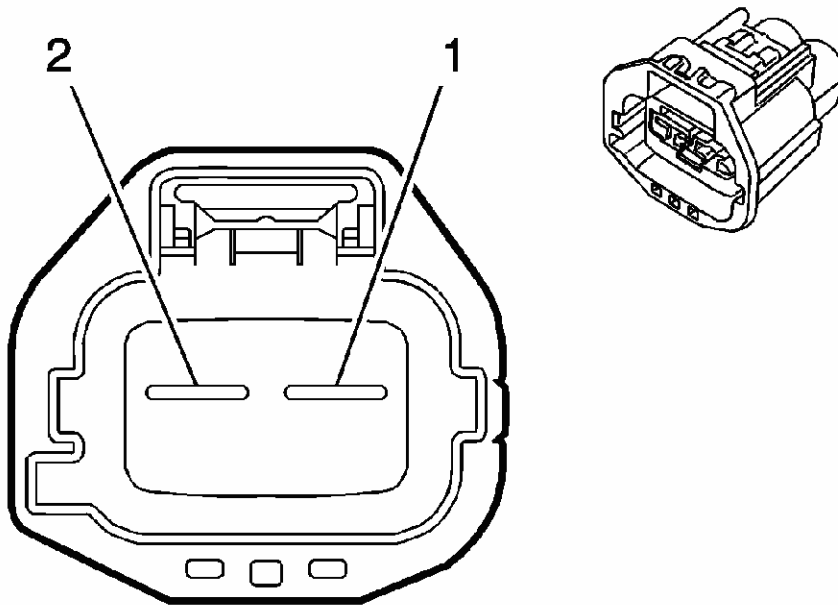
- Terminal/Tray: 7116-4142-02/10
- Core/Insulation Crimp: A/3
- Release Tool/Test Probe: 12094430/J-35616-42 (RD)

### Cooling Fan - Left

Pin	Wire Color	Circuit No.	Function
1	WH	504	Cooling Fan Low Reference
2	GY	532	Cooling Fan Motor Supply Voltage

### Cooling Fan - Right





**Fig. 4: Right Cooling Fan Connector End View**  
 Courtesy of GENERAL MOTORS CORP.

### Cooling System Connector End Views

#### Connector Part Information

- OEM: 7283-5596-10
- Service: 88953307
- Description: 2-Way F 6.3 (GY)

#### Terminal Part Information

- Terminal/Tray: 7116-4142-02/10
- Core/Insulation Crimp: A/3
- Release Tool/Test Probe: 12094430/J-35616-42 (RD)

### Cooling Fan - Right

Pin	Wire Color	Circuit No.	Function
1	L-BU	409	Cooling Fan Motor Supply Voltage
2	BK	250	Ground

## DIAGNOSTIC INFORMATION AND PROCEDURES

### DIAGNOSTIC CODE INDEX

### DIAGNOSTIC CODE INDEX

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### DTC

**DTC P0480 or P0481**

**DTC P1258**

### Description

**\*\* MULTIPLE VALUES \*\***

Engine Coolant Overtemperature-Protection Mode Active

### DIAGNOSTIC STARTING POINT - ENGINE COOLING

Begin the system diagnosis with the **Diagnostic System Check - Vehicle** . The Diagnostic System Check will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and their status

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

### SCAN TOOL OUTPUT CONTROLS

#### Engine Control Module (ECM) Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selection (s)	Description
Fan Relay 1	Fan Relays	The scan tool displays a Commanded State of None, Off or On. This allows you to communicate with the powertrain control module (PCM) and activate or deactivate the cooling fan 1 relay, manually turning the low speed fans On and Off.
Fan Relay 2	Fan Relays	The scan tool displays a Commanded State of None, Off or On. This allows you to communicate with the PCM to activate or deactivate the cooling fan 1 relay, manually turning the low speed fans On. After a 3 second delay the PCM will activate the cooling fan 2 relay and the cooling fan 3 relay. This turns the high speed fans On and Off.

### SCAN TOOL DATA LIST

#### Scan Tool Data List

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
<b>Operating Conditions: Ignition ON, Engine OFF</b>			
Cooling Fan After Run	Engine Data 2,	Not	Not Requested

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ECT	Engine Data 3 Engine Data 1, Engine Data 2, Cooling/HVAC Data, EVAP Data, Fuel Trim Data	Requested/Requested  °C/°F	Varies
FC Relay 1 Command	Engine Data 2, Cooling/HVAC Data	On/Off	Varies
FC Relay 2 and 3 Command	Engine Data 2, Cooling/HVAC Data	On/Off	Varies
Low Coolant Status	HVAC System Data	OK/Low	OK
Low Coolant Switch	HVAC System Data	Open/Closed	Open

**SCAN TOOL DATA DEFINITIONS****Cooling Fan After Run**

The scan tool displays Not Requested/Requested. If the engine coolant temperature is greater than 101°C (214°F) when the engine is turned Off, the engine control module (ECM) will request low speed cooling fan operation, in conjunction with the after-boil coolant pump operation. If the engine coolant temperature is less than 101°C (214°F) after 60 seconds, the ECM will turn the cooling fans Off. Otherwise, the ECM will turn Off the cooling fans and the after-boil coolant pump after 180 seconds on domestic vehicles and 300 seconds on export vehicles.

**ECT**

The scan tool displays -40 to +151°C (-40 to +304°F). The engine coolant temperature (ECT) sensor is mounted in the coolant stream. The ECM applies 5 volts to the ECT sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes. When the sensor is cold (internal resistance high), the ECM monitors a high signal voltage and interprets it as a cold engine. As the sensor warms and internal resistance decreases, the voltage signal decreases and the ECM interprets the lower voltage as a warm engine.

**Engine Coolant Fan**

The scan tool displays OFF, Level 1, Level 2 or Level 3. When the scan tool displays

Level 1, the ECM is commanding the low speed fan control relay On. When the ECM commands the low speed fan relay On, the left and right cooling fans are enabled in low speed. When the scan tool displays Level 2, the ECM is commanding the low speed, high speed and S/P fan relays On. When the low speed, high speed and S/P fan relays are On, the left and right cooling fans are enabled in high speed. When the scan tool displays Level 3, the ECM is commanding all fan relays On. When all fan relays are activated, the left and right cooling fans are enabled in high speed and the auxiliary cooling fan, if equipped, is enabled.

### **Low Coolant Status**

The scan tool displays OK/Low. When the scan tool displays Low, a low voltage level has been detected on the coolant level switch signal circuit, indicating a low coolant level condition.

### **Low Coolant Switch**

The scan tool displays Open/Closed. When the scan tool displays Open, the coolant level has fallen below a certain level, causing the low coolant level switch to open and the check coolant level display should be activated.

### **DTC P0480 OR P0481**

#### **Circuit Description**

The powertrain control module (PCM) controls the low speed cooling fan operation by grounding the low speed fan relay control circuit with an internal solid state device called a driver. For high speed cooling fan operation, the PCM grounds the high speed and S/P relay control circuit at the same time the low speed control circuit is grounded. Battery positive voltage is supplied to the low speed, high speed and S/P fan relays. When the PCM is commanding a fan relay ON, the voltage of the control circuit should be low, near 0 volts. When the PCM is commanding a fan relay OFF, the voltage potential of the control circuit should be high, near battery voltage.

The PCM monitors the relay control circuits for the following conditions:

- Short to ground
- Short to voltage
- An open circuit

If the PCM detects an improper voltage level on the low or high speed driver circuits, then code P0480 or P0481 will set and the effected driver will be disabled.

- Cooling fan relay 1 control circuit refers to the low speed cooling fan relay

- Cooling fan relay 2 control circuit refers to the high speed cooling fan relay

**DTC Descriptors**

This diagnostic procedure supports the following DTCs:

- DTC P0480 Cooling Fan Relay 1 Control Circuit
- DTC P0481 Cooling Fan Relay 2 Control Circuit

**Conditions for Running the DTC**

- The ignition voltage is between 8-18 volts.
- The engine speed is more than 40 RPM.
- The ECM driver transitions from ON to OFF or from OFF to ON.

**Conditions for Setting the DTC**

- P0481-The PCM detects an open circuit on the high speed cooling fan relay control circuit.
- P0480-The PCM detects an open on the low speed cooling fan relay control circuit.
- The above condition is present for one second.

**Action Taken When the DTC Sets**

- The PCM will illuminate the malfunction indicator lamp (MIL) during the second consecutive trip in which the diagnostic test has been run and failed.
- The PCM will store conditions which were present when the DTC set as Freeze Frame and Failure Records data.

**Conditions for Clearing the MIL/DTC**

- The PCM will turn OFF the MIL during the third consecutive trip in which the diagnostic has been run and passed.
- The History DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- Use the scan tool Clear DTC Information function.

**Diagnostic Aids**

- If the condition is not present, refer to **Testing for Intermittent Conditions and Poor Connections** .
- Review the Freeze Frame/Failure Records vehicle mileage since the diagnostic test failed. This may help determine how often the condition that caused the DTC to be set occurs.

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**Test Description**

The numbers below refer to the step numbers on the diagnostic table.

**2:** Listen for an audible click when the low speed fan relay operates. Command both the ON and OFF states. Repeat the commands as necessary.

**3:** Listen for an audible click when the S/P and high speed fan relays operate. Command both the ON and OFF states. Repeat the commands as necessary.

**DTC P0480 or P0481**

Step	Action	Yes	No
<b>Schematic Reference: <u>Engine Cooling Schematics</u></b>			
<b>Connector End View Reference: <u>Cooling System Connector End Views</u></b>			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Vehicle</u></b>
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the Fans Low Speed ON and OFF.		
3	Does the low speed fan relay turn ON and OFF with each command? With a scan tool, command the Fans High Speed ON and OFF. Do the S/P and the high speed fan relays turn ON and OFF with each command?	Go to <b>Step 3</b>	Go to <b>Step 4</b>
4	1. Turn OFF the ignition. 2. Disconnect the low speed fan relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 3 voltage circuit of the low speed fan relay with a test lamp that is connected to a good ground.	Go to Diagnostic Aids	Go to <b>Step 6</b>
	Does the test lamp illuminate?	Go to <b>Step 5</b>	Go to <b>Step 16</b>

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Step	Action	Yes	No
<b>Schematic Reference: Engine Cooling Schematics</b> <b>Connector End View Reference: Cooling System Connector End Views</b>			
1	1. Connect a test lamp between the control circuit of the low speed fan relay and a good ground. Does the test lamp illuminate? 2. With a scan tool, command the Fans Low Speed ON and OFF.	Go to <b>Step 2</b>	Go to <b>Diagnostic System Check Vehicle</b>
2	1. Install a scan tool. Does the test lamp turn ON and OFF with each command? 2. Turn ON the ignition, with the engine OFF. 1. Turn OFF the ignition. 3. With a scan tool, command the Fans Low Speed ON and OFF. 2. Disconnect the high speed fan relay. Does the low speed fan relay turn ON and OFF with each command?	Go to <b>Step 12</b>	Go to <b>Step 9</b>
3	4. With a scan tool, command the Fans High Speed ON and OFF. Probe the ignition 3 voltage circuit of the high speed fan relay. Do the S/P and the high speed fan relays with a test lamp that is connected to a good ground. Does the test lamp illuminate?	Go to Diagnostic	Go to <b>Step 16</b>
7	1. Connect a test lamp between the control circuit of the high speed fan relay and the ignition 3 voltage circuit of the high speed fan relay. 2. With a scan tool, command the Fans High Speed ON and OFF. Does the test lamp turn ON and OFF with each command?	Go to <b>Step 7</b>	Go to <b>Step 16</b>
8	1. Turn OFF the ignition. 2. Disconnect the S/P fan relay. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the control circuit of the S/P fan relay and the ignition 3 voltage circuit of the S/P fan relay. 5. With a scan tool, command the	Go to <b>Step 14</b>	Go to <b>Step 8</b>

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	turn ON and OFF the ignition and command?	Aids	Go to Step 6
9	1. Turn OFF the ignition. Does the test lamp turn ON and OFF with each command? 2. Disconnect the low speed fan relay. Does the test lamp remain illuminated with the engine OFF?	Go to Step 13 Go to Step 11	Go to Step 9 Go to Step 10
4	3. Turn ON the ignition, with the engine OFF. Test the control circuit of the voltage circuit of the relay speed fan relay with a test-lamp that is connected to a good ground.		
10	4. Probe the ignition 3 voltage circuit of the high speed fan relay with a test-lamp that is connected to a good ground. <b>Testing for Intermittent Conditions and Poor Connections and Wiring Repairs .</b> Does the test lamp illuminate?	Go to Step 5	Go to Step 10
11	5. Did you find and correct the condition?	Go to Step 21	Go to Step 15
5	Test the control circuit of the appropriate relay for short to ground. Refer to <b>Testing for Intermittent Conditions and Poor Connections and Wiring Repairs</b> . With a scan tool, command the Fans Low Speed ON and OFF. Did you find and correct the condition?	Go to Step 21	Go to Step 15
12	Inspect for poor connections at the low speed fan relay. Does the test lamp turn ON and OFF with each command? <b>Testing for Intermittent Conditions and Poor Connections and Connector Repairs</b>	Go to Step 12	Go to Step 9
13	1. Turn ON the ignition. 2. Disconnect the high speed fan relay. Did you find and correct the condition? Inspect for poor connections at the S/P fan relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 3 voltage circuit of the high speed fan relay with a test-lamp that is connected to a good ground. Did you find and correct the condition? Inspect for poor connections at the high speed fan relay. Refer to <b>Testing for Intermittent Conditions and Poor Connections and Connector Repairs</b> . Does the test lamp illuminate?	Go to Step 21 Go to Step 21 Go to Step 21 Go to Step 21 Go to Step 7	Go to Step 17 Go to Step 18 Go to Step 10
14	1. Connect a test lamp between the control circuit of the high speed fan relay and the ignition 3 voltage circuit of the high speed fan relay. Did you find and correct the condition?	Go to Step 21	Go to Step 19
7	Inspect for poor connections at the harness connector of the powertrain control module (PCM). 2. With a scan tool, command the Fans High Speed ON and OFF. <b>Testing for Intermittent Conditions and Poor Connections and Connector Repairs .</b>		
15			



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	Does the test lamp illuminate ON and OFF with each command?	Go to <b>Step 21</b>	Go to <b>Step 20</b>
	Repair the ignition's voltage circuit for an open or high resistance. Refer to <b>Wiring Repairs</b> .	Go to <b>Step 14</b>	Go to <b>Step 8</b>
16	1. Turn OFF the ignition. Did you complete the repair?	Go to <b>Step 21</b>	-
17	2. Disconnect the S/P fan relay. Replace the low speed fan relay with the engine OFF. Did you complete the repair?	Go to <b>Step 21</b>	-
18	3. Replace the S/P fan relay. Connect a test lamp between the control circuit of the S/P fan relay and the high speed fan relay circuit of the S/P fan relay. Did you complete the repair?	Go to <b>Step 21</b>	-
8	4. Replace the high speed fan relay.	Go to <b>Step 21</b>	-
19	Did you complete the repair?	Go to <b>Step 21</b>	-
20	Replace the PCM. Refer to <b>Control Module References</b> for replacement, setup and programming. Does the test lamp illuminate ON and OFF with each command?	Go to <b>Step 21</b>	-
	1. Use the scan tool in order to clear the DTCs.	Go to <b>Step 13</b>	Go to <b>Step 9</b>
9	2. Does the test lamp remain illuminated with each command?	Go to <b>Step 11</b>	Go to <b>Step 10</b>
21	3. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text.		
10	Test the control circuit of the appropriate relay for a short to voltage or an open. Refer to <b>Testing for Intermittent Conditions and Poor</b>	Go to <b>Step 2</b>	System OK

### DTC P1258

#### Circuit Description

The engine control module (ECM) uses the engine coolant temperature (ECT) sensor to monitor the engine for an over temperature condition. This condition occurs when the coolant temperature is above 131°C (268°F). When an over temperature condition is present, DTC P1258 will set. The ECM will disable 2 groups of 4 cylinders by turning OFF the fuel injectors. By switching between the 2 groups of cylinders, the ECM is able to reduce the temperature of the coolant.

#### DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P1258 Engine Coolant Overtemperature-Protection Mode Active

#### Conditions for Running the DTC

The ignition is ON.

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#### Conditions for Setting the DTC

- The ECM detects an ECT over 131°C (268°F).
- The above condition is present for at least 3 seconds.

#### Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) during the first trip in which the diagnostic test has been run and failed.
- The ECM will signal the instrument panel cluster (IPC) to turn ON the Service Engine Soon indicator.
- The ECM will alternately disable 2 groups of 4 cylinders by turning OFF the fuel injectors.
- The ECM will store conditions which were present when the DTC set in Freeze Frame Data.
- The ECM will command the fan on high speed.

#### Conditions for Clearing the MIL/DTC

- The ECM will turn the MIL OFF after 4 consecutive trips that the diagnostic has been run and passed.
- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- The DTC can be cleared by using the scan tool Clear DTC Information function.

#### DTC P1258

Step	Action	Yes	No
<b>Connector End View Reference: <u>Cooling System Connector End Views</u></b>			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Vehicle</u></b>
2	Inspect the engine cooling fans for proper operation. Are the engine cooling fans operative?	Go to <b><u>Engine Overheating</u></b>	Go to <b><u>Symptoms - Engine Cooling</u></b>

#### SYMPTOMS - ENGINE COOLING

**IMPORTANT:** Review the system operation in order to familiarize yourself with the system functions. Refer to Cooling System Description and Operation.

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- Inspect for aftermarket devices which could affect the operation of the Cooling System. Refer to **Checking Aftermarket Accessories** in Wiring Systems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the surge tank reservoir for the proper coolant level.

#### Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.

#### Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Low Engine Coolant Indicator Always On**
- **Cooling Fan Always On**
- **Cooling Fan Inoperative**
- **Engine Overheating**
- **Loss of Coolant**
- **Thermostat Diagnosis**
- **Engine Fails To Reach Normal Operating Temperature**
- **Pressure Cap Testing**
- **Cooling System Leak Testing**

#### LOW ENGINE COOLANT INDICATOR ALWAYS ON

##### Low Engine Coolant Indicator Always On

Step	Action	Yes	No
<b>Schematic Reference: <u>Engine Cooling Schematics</u></b> <b>Connector End View Reference: <u>Cooling System Connector End Views</u></b> DEFINITION: The check coolant level display is always on when the key is in the ON position.			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Vehicle</u></b>
	1. Turn ON the ignition, with the engine OFF.		Go to <b>Testing</b>

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2	<p>2. With a scan tool, observe the Low Coolant Switch parameter in the HVAC Automatic data list.</p>	Go to <b>Step 3</b>	<u>for</u> <b><u>Intermittent</u></b> <b><u>Conditions and</u></b> <b><u>Poor</u></b> <b><u>Connections</u></b>
3	<p>Does the low coolant switch display open?</p> <p>1. Disconnect the coolant level switch connector.</p> <p>2. Connect a 3-amp fused jumper wire between the coolant level switch signal circuit and the coolant level switch ground circuit, at the harness connector of the coolant level switch.</p>		
4	<p>Does the low coolant switch display closed on the scan tool?</p> <p>Connect a 3-amp fused jumper wire from the coolant level switch signal circuit at the coolant level switch harness connector to a good ground.</p> <p>Does the low coolant switch display closed on the scan tool?</p>		
5	<p>Test the signal circuit of the coolant level switch for an open. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> .</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 6</b>	Go to <b>Step 5</b>
6	<p>Repair the open or high resistance in the coolant level switch ground circuit. Refer to <b><u>Wiring Repairs</u></b> .</p> <p>Did you complete the repair?</p>	Go to <b>Step 11</b>	-
7	<p>Inspect for poor connections at the harness connector of the coolant level switch. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and <b><u>Connector Repairs</u></b> .</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 11</b>	Go to <b>Step 9</b>
8	<p>Inspect for poor connections at the harness connector of the HVAC control module. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and</p>		

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Step	Connector Repair Action	Yes	No
	<b>Schematic Reference:</b> <u>Engine Cooling Schematics</u> <b>Connector End View Reference:</b> <u>Cooling System Connector End Views</u> <b>DEFINITION:</b> Radiator Surge Tank Replacement is always on when the key is in the ON position.	Go to <b>Step 11</b>	Go to <b>Step 10</b>
1	Did you complete the replacement?	Go to <b>Step 11</b>	Go to <b>Diagnostic System Check - Vehicle</b>
10	Replace the HVAC control module. Refer to <b>Control Module References</b> for replacement, setup and programming.	Go to <b>Step 2</b>	
11	Did you complete the repair? 1. Turn ON the ignition, with the engine OFF. Operate the system in order to verify the repair.	Go to <b>Step 11</b>	-
2	2. With a scan tool, observe the Low Coolant Switch parameter in the	System OK	Go to <b>Testing for Intermittent</b>

### COOLING FAN ALWAYS ON

#### Cooling Fan Always On

Step	Action	Yes	No
	<b>Schematic Reference:</b> <u>Engine Cooling Schematics</u> <b>Connector End View Reference:</b> <u>Cooling System Connector End Views</u> <b>DEFINITION:</b> One or both fan motors run continuously in high or low speed.		
1	Did you perform the Diagnostic System Check - Vehicle?	Go to <b>Step 2</b>	Go to <b>Diagnostic System Check - Vehicle</b>
2	Turn ON the ignition, with the engine OFF. Are both cooling fans operating at low speed?	Go to <b>Step 4</b>	Go to <b>Step 3</b>
3	Is the left cooling fan operating at high speed?	Go to <b>Step 5</b>	Go to <b>Testing for Intermittent Conditions and Poor Connections</b>
4	Remove the low speed fan relay. Did the fans turn OFF?	Go to <b>Step 8</b>	Go to <b>Step 6</b>
5	Remove the high speed fan relay. Did the left cooling fan turn OFF?	Go to <b>Step 9</b>	Go to <b>Step 7</b>
	Repair the cooling fan motor supply voltage circuit of the right cooling fan		

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6	for a short to voltage. Refer to <b><u>Wiring Repairs</u></b> . Did you complete the repair?	Go to <b>Step 12</b>	-
7	Repair the cooling fan motor supply voltage circuit of the left cooling fan for a short to voltage. Refer to <b><u>Wiring Repairs</u></b> . Did you complete the repair?	Go to <b>Step 12</b>	-
8	Inspect for poor connections at the low speed fan relay. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and <b><u>Connector Repairs</u></b> . Did you find and correct the condition?	Go to <b>Step 12</b>	Go to <b>Step 10</b>
9	Inspect for poor connections at the high speed fan relay. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and <b><u>Connector Repairs</u></b> . Did you find and correct the condition?	Go to <b>Step 12</b>	Go to <b>Step 11</b>
10	Replace the low speed fan relay. Did you complete the replacement?	Go to <b>Step 12</b>	-
11	Replace the high speed fan relay. Did you complete the replacement?	Go to <b>Step 12</b>	-
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 2</b>

### COOLING FAN INOPERATIVE

#### Cooling Fan Inoperative

Step	Action	Yes	No
<b>Schematic Reference: <u>Engine Cooling Schematics</u></b> <b>Connector End View Reference: <u>Cooling System Connector End Views</u></b> <b>DEFINITION:</b> One or both fan motors are inoperative in either high, low or both speeds.			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Vehicle</u></b>
	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF.		

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<p>2</p> <p>3</p> <p>4</p>	<p>3. With a scan tool, command the Fans Low Speed ON and OFF.</p> <p>Do the low speed engine cooling fans turn ON and OFF with each command?</p> <p><b>IMPORTANT:</b> A 3 second delay occurs before the powertrain control module (PCM) changes the cooling fan speed.</p> <p>With a scan tool, command the Fans High Speed ON and OFF. Do the high speed engine cooling fans turn ON and OFF with each command?</p> <p><b>IMPORTANT:</b> Do NOT remove the jumper wire that you will be connecting until your testing is completed. If the low speed fan fuse opens when you connect the jumper wire, repair the cooling fan motor supply voltage circuit of the right cooling fan motor for a short to ground.</p> <p>1. Disconnect the low speed fan relay. 2. Connect a jumper wire between the battery positive voltage circuit and the cooling fan motor supply voltage circuit of the low speed fan relay.</p> <p>Do both cooling fans operate in low speed?</p>	<p>Go to <b>Step 3</b></p> <p>Go to <u>Testing for Intermittent Conditions and Poor Connections</u></p> <p>Go to <b>Step 14</b></p>	<p>Go to <b>Step 4</b></p> <p>Go to <b>Step 6</b></p> <p>Go to <b>Step 5</b></p>
<p>5</p>	<p>1. Disconnect the S/P fan relay. 2. With a test lamp connected to a good ground, probe the cooling fan low reference circuit at the S/P fan relay.</p> <p>Does the test lamp illuminate?</p>	<p>Go to <b>Step 9</b></p>	<p>Go to <b>Step 8</b></p>
<p>6</p>	<p>Does the right cooling fan operate at high speed?</p>	<p>Go to <b>Step 16</b></p>	<p>Go to <b>Step 7</b></p>
	<p>Inspect the ground circuit of the S/P fan</p>		

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Step	relay for an open or high resistance.	Yes	No
<b>Schematic</b>	<b>Refer to <u>Circuit Testing and Wiring Repairs</u>.</b>		
<b>Connector</b>	<b>Repair Reference: Cooling System Connector End Views</b>		
<b>DEFINITION</b>	Did you find and correct the condition?	Go to <b>Step 25</b>	Go to <b>Step 15</b>
1	<p>1. Did you perform the Diagnostic System Check - Vehicle?</p> <p>2. Disconnect the right cooling fan electrical connector.</p>	Go to <b>Step 2</b>	Go to <b>Diagnostic System Check Vehicle</b>
8	<p>3. With a test lamp connected to a good ground, probe the cooling fan motor supply voltage circuit at the right cooling fan motor connector.</p>		
2	<p>1. Does the test lamp illuminate?</p> <p>2. Low Speed ON and OFF.</p> <p>1. Install the S/P fan relay.</p> <p>2. Do the low speed engine cooling fans turn ON and OFF with each command?</p>	Go to <b>Step 12</b>	Go to <b>Step 13</b>
9	<p><b>IMPORTANT:</b></p> <p>3. With a test lamp connected to a good ground, probe the cooling fan motor supply voltage circuit at the left cooling fan connector.</p>		
3	<p>With a scan tool, command the Fans High Speed ON and OFF. Do the high speed engine cooling fans turn ON and OFF?</p>	Go to <b>Testing for Intermittent Conditions and Poor</b>	Go to <b>Step 10</b>
10	<p>Inspect the cooling fan motor supply voltage circuit for an open or high resistance. Refer to <b>Circuit Testing and Wiring Repairs</b>.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 25</b>	Go to <b>Step 15</b>
11	<p>Inspect the ground circuit of the left cooling fan for an open or high resistance. Refer to <b>Circuit Testing and Wiring Repairs</b>.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 25</b>	Go to <b>Step 18</b>
12	<p>Inspect the cooling fan low reference circuit for an open or high resistance. Refer to <b>Circuit Testing and Wiring Repairs</b>.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 25</b>	Go to <b>Step 17</b>
13	<p>Inspect the cooling fan motor supply voltage circuit of the right cooling fan for an open or high resistance. Refer to <b>Circuit Testing and Wiring Repairs</b>.</p>		



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	Did you find and correct the condition?	Go to Step 25	Go to Step 19
14	<p><b>IMPORTANT:</b> Do NOT remove the jumper wire that you will be connecting until your testing is completed. If the low speed fan fuse opens when you connect the jumper wire, repair the cooling fan motor supply voltage circuit of the right cooling fan motor for a short to ground. Refer to <b>Testing for Intermittent Conditions and Poor Connections and Connector Repairs</b>.</p> <p>1. Disconnect the low speed fan relay. Did you find and correct the condition?</p> <p>2. Connect a jumper wire between the battery positive voltage circuit and the cooling fan motor supply voltage circuit of the low speed fan relay. Did you find and correct the condition?</p>	Go to Step 25	Go to Step 20
15 4	<p>Inspect for poor connections at the harness connector of the right cooling fan. Refer to <b>Testing for Intermittent Conditions and Poor Connections and Connector Repairs</b>.</p> <p>1. Disconnect the S/P fan relay. Did you find and correct the condition?</p> <p>2. Connect a jumper wire between the battery positive voltage circuit and the cooling fan low reference circuit at the S/P fan relay. Did you find and correct the condition?</p>	Go to Step 25	Go to Step 21
16	<p>Inspect for poor connections at the harness connector of the left cooling fan. Does the right cooling fan operate at high speed? Refer to <b>Testing for Intermittent Conditions and Poor Connections and Connector Repairs</b>.</p> <p>Inspect the ground circuit of the S/P fan relay for an open or high resistance. Refer to <b>Circuit Testing and Wiring Repairs</b>. Repair the battery positive voltage circuit for an open or high resistance. Did you find and correct the condition?</p>	Go to Step 25	Go to Step 22
	Do both cooling fans operate in low speed?	Go to Step 14	Go to Step 5
17 5	<p>1. Disconnect the S/P fan relay. Refer to <b>Testing for Intermittent Conditions and Poor Connections and Connector Repairs</b>.</p> <p>2. With a test lamp connected to a good ground, probe the cooling fan low reference circuit at the S/P fan relay. Did you find and correct the condition?</p>	Go to Step 25	Go to Step 23
	Does the test lamp illuminate?	Go to Step 9	Go to Step 8
18	<p>Does the right cooling fan operate at high speed? Refer to <b>Testing for Intermittent Conditions and Poor Connections and Connector Repairs</b>.</p> <p>Inspect the ground circuit of the S/P fan relay for an open or high resistance. Refer to <b>Circuit Testing and Wiring Repairs</b>. Did you find and correct the condition?</p>	Go to Step 16	Go to Step 7
7	<p>Repair the battery positive voltage circuit for an open or high resistance. Did you find and correct the condition?</p>	Go to Step 25	Go to Step 24
	Did you find and correct the condition?	Go to Step 25	Go to Step 13
19	<p>Refer to <b>Wiring Repairs</b>. Install the S/P fan relay. Did you complete the repair?</p>	Go to Step 25	-
20 8	<p>Replace the low speed fan relay. Did you complete the replacement?</p> <p>With a test lamp connected to a good ground, probe the cooling fan low reference circuit at the S/P fan relay. Did you find and correct the condition?</p>	Go to Step 25	-
21	<p>Replace the S/P fan relay. Did you complete the replacement?</p> <p>Replace the right cooling fan motor. Did you complete the replacement?</p>	Go to Step 25	-
22	<p>Replace the high speed fan motor. Did you complete the replacement?</p>	Go to Step 25	-
23	<p>Replace the right cooling fan. Refer to <b>Engine Cooling Fan Replacement</b>. Did you complete the replacement?</p>	Go to Step 25	-

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	Replace the test lamp and fan motor. Refer to	Go to <b>Step 12</b>	Go to <b>Step 11</b>
24	<b>Engine Cooling Fan Replacement.</b> 1. Install the S/P fan relay. Did you complete the replacement?	Go to <b>Step 25</b>	-
25	2. Disconnect the left cooling fan motor Operate the system in order to verify the connector. repair.		
9	3. With a test lamp connected to a good Did you correct the condition?	System OK	Go to <b>Step 3</b>

## ENGINE OVERHEATING

### Engine Overheating

Step	Action	Value(s)	Yes	No
DEFINITION: The engine temperature lamp comes on and stays on or the temperature gauge shows hot or coolant overflows from the surge tank onto the ground while the engine is running.				
1	Check for low coolant. Is the coolant low?	-	Go to <b>Step 2</b>	Go to <b>Step 3</b>
2	Fill the system to the specified level. Does the engine still overheat?	-	Go to <b>Step 3</b>	System OK
3	Check for a missing or damaged radiator upper air deflector, baffle or center air deflector. Are there any missing or damaged deflectors or baffles?	-	Go to <b>Step 4</b>	Go to <b>Step 5</b>
4	Repair or replace any deflectors or baffles as necessary. Does the engine still overheat?	-	Go to <b>Step 5</b>	System OK
5	Check the coolant concentration. Is the coolant concentration adequate?	-	Go to <b>Step 7</b>	Go to <b>Step 6</b>
6	Correct the coolant concentration as necessary. Does the engine still overheat?	-	Go to <b>Step 7</b>	System OK
7	Pressure test the cooling system. Does the cooling system maintain the correct pressure?	103 kPa (15 psi)	Go to <b>Step 9</b>	Go to <b>Step 8</b>
8	Refer to <b>Loss of Coolant</b> . Does the engine still overheat?	-	Go to <b>Step 9</b>	System OK
9	Check for a pinched or kinked radiator surge tank hose. Is the surge tank hose kinked or	-	Go to <b>Step</b>	Go to <b>Step</b>

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	damaged?		<b>10</b>	<b>11</b>
10	Reroute or replace the hose as necessary. Does the engine still overheat?	-	Go to <b>Step 11</b>	System OK
11	Check the water pump belt tension. Is the tensioner working properly?	-	Go to <b>Step 13</b>	Go to <b>Step 12</b>
12	Replace the tensioner as necessary. Does the engine still overheat?	-	Go to <b>Step 13</b>	System OK
13	Check for an obstructed radiator air flow or bent fins. Are any radiator fins bent or is air flow to the radiator being obstructed?	-	Go to <b>Step 14</b>	Go to <b>Step 15</b>
14	Remove or relocate add on parts that block air flow to the radiator. Does the engine still overheat?	-	Go to <b>Step 15</b>	System OK
15	Check for a blockage in the cooling system passages. Are the cooling system passages blocked?	-	Go to <b>Step 16</b>	Go to <b>Step 17</b>
16	1. Drain the coolant. Refer to <b><u>Cooling System Draining and Filling (Static Fill)</u></b> or <b><u>Cooling System Draining and Filling (Vac-N-Fill)</u></b> . 2. Flush the cooling system. Refer to <b><u>Flushing</u></b> . Does the engine still overheat?	-	Go to <b>Step 17</b>	System OK
17	Check for an inoperative cooling fan. Are the cooling fans inoperative?	-	Go to <b>Step 18</b>	Go to <b>Step 19</b>
18	Repair or replace the cooling fan as necessary. Refer to <b><u>Engine Coolant Fan Motor Replacement</u></b> . Does the engine still overheat?	-	Go to <b>Step 19</b>	System OK
	Check if the thermostat is stuck in			

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Step	Action	Value(s)	Yes	No
10	Is the thermostat sticking or stuck in the closed position?		Go to Step 20	Go to Step 21
20	Is the engine temperature gauge shows hot or closed position? Is the surge tank on the ground while the engine is running.			
1	Replace the thermostat. Refer to <u>Engine Coolant Thermostat Replacement (LD6)</u> or <u>Engine Coolant Thermostat Replacement (LD8)</u> .	-	Go to Step 2	Go to Step 2
2	Fill the system to the specified level. Does the engine still overheat?	-	Go to Step 21	System OK
21	Check for a faulty water pump. Is the water pump faulty?	-	Go to Step 22	-
3	Replace the water pump. Refer to <u>Water Pump Replacement (LD26)</u> or <u>Water Pump Replacement (LD8)</u> .	-		
22	Check for any deflected or damaged radiator upper air deflector, baffle or radiator. Does the engine still overheat?	-	Go to Step 4	Go to Step 4
4	Does the engine still overheat?	-	-	System OK

### LOSS OF COOLANT

#### Loss of Coolant

Step	Action	Yes	No
DEFINITION: The cooling system is losing coolant either internally or externally.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to Step 2	Go to <u>Symptoms - Engine Cooling</u>
2	Repair any present DTCs. Refer to <u>Diagnostic System Check - Vehicle</u> . Is the action complete?	Go to Step 3	-
3	Inspect the coolant level. Is the coolant at the proper level?	Go to Step 6	Go to Step 4
4	Fill the cooling system to the proper level. Refer to <u>Cooling System Draining and Filling (Static Fill)</u> or <u>Cooling System Draining and Filling (Vac-N-Fill)</u> . Is the action complete?	Go to Step 5	-
5	If the engine is suspected to have a coolant leak into a cylinder, the coolant can hydraulically lock the engine. Does the engine crankshaft rotate?	Go to Step 6	Go to Step 26
	Engine overheating can cause a loss of		

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6	coolant. Is the engine overheating?	Go to <b>Step 27</b>	Go to <b>Step 7</b>
7	Extended operation with a low coolant level can cause engine internal component failure. Is the engine knocking?	Go to <b>Step 29</b>	Go to <b>Step 8</b>
8	<ol style="list-style-type: none"> <li>1. Idle the engine at normal operating temperature.</li> <li>2. Inspect for heavy white smoke coming out of the exhaust pipe.</li> </ol> Is a heavy white smoke present from the exhaust pipe?	Go to <b>Step 9</b>	Go to <b>Step 10</b>
9	Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor?	Go to <b>Step 28</b>	Go to <b>Step 10</b>
10	With the engine idling, inspect the surge tank system. Does the surge tank system discharge coolant while the engine is idling?	Go to <b>Step 15</b>	Go to <b>Step 11</b>
11	Visually inspect the hoses, pipes and hose clamps at the following locations: <ul style="list-style-type: none"> <li>• Coolant crossover</li> <li>• Engine</li> <li>• Surge tank</li> <li>• Heater core</li> <li>• Radiator</li> </ul> Are any of the hoses, clamps or pipes leaking?	Go to <b>Step 20</b>	Go to <b>Step 12</b>
	Visually inspect the following components: <ul style="list-style-type: none"> <li>• Coolant pressure cap</li> </ul>		

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Step	Action	Yes	No
DEFINITION: The cooling system is losing coolant either internally or externally.			
1	<ul style="list-style-type: none"> <li>Core plugs</li> <li>Cylinder head gaskets</li> <li>Engine block</li> <li>Intake manifold</li> </ul> Were you sent here from Symptoms or another diagnostic table?	Go to <b>Step 2</b>	Go to <b>Symptoms - Engine Cooling</b>
12 2	<ul style="list-style-type: none"> <li>Radiator</li> </ul> Repair any present DTCs. Refer to <b>Diagnostic System Check - Vehicle</b> . Is the action complete?	Go to <b>Step 3</b>	-
3	Inspect the coolant level. Is the coolant at the proper level?	Go to <b>Step 6</b>	Go to <b>Step 4</b>
4	Are any of the listed components leaking? Refer to <b>Cooling System Draining and Filling (Static Fill)</b> or <b>Cooling System Draining and Filling (Vac-N-Fill)</b> . Is the action complete?	Go to <b>Step 20</b>  Go to <b>Step 5</b>	Go to <b>Step 13</b>  -
13 5	If the engine is suspected to have a pressurized, visually inspect the coolant leak into a cylinder, the coolant can hydraulically lock the engine. Does the engine crankshaft rotate?	Go to <b>Step 6</b>	Go to <b>Step 20</b>
	Engine leaks present?	Go to <b>Step 20</b>	Go to <b>Step 14</b>
14	Pressure test the coolant pressure cap. Refer to <b>Pressure Cap Testing</b> . Does the coolant pressure cap hold pressure?	Go to <b>Step 16</b>	Go to <b>Step 21</b>
15	Pressure test the coolant pressure cap. Refer to <b>Pressure Cap Testing</b> . Does the coolant pressure cap hold pressure?	Go to <b>Step 30</b>	Go to <b>Step 21</b>
16	Inspect for the following conditions: <ul style="list-style-type: none"> <li>A coolant smell inside of the vehicle</li> <li>Coolant in the HVAC module drain tube</li> <li>Coolant on the vehicle floor covering near the HVAC module</li> </ul> Is coolant present?	Go to <b>Step 22</b>	Go to <b>Step 17</b>
	Inspect the underside of the engine oil		

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6	1. Look for a gray/white milky substance on the engine oil fluid level indicator?	Go to <b>Step 27</b>	Go to <b>Step 7</b>
17	Is there a milky substance under the oil filler cap?	Go to <b>Step 18</b>	Go to <b>Step 19</b>
7	Inspect the engine oil fluid level indicator for a gray/white milky substance.	Go to <b>Step 29</b>	Go to <b>Step 8</b>
18	1. Idle the engine at normal operating temperature. Is there a milky substance on the engine oil fluid level indicator?	Go to <b>Step 28</b>	Go to <b>Step 19</b>
8	2. Inspect for heavy white smoke coming out of the exhaust pipe.		
19	Inspect the automatic transmission oil fluid level indicator, if equipped, for a gray/white milky substance.	Go to <b>Step 9</b>	Go to <b>Step 10</b>
	Is there a milky substance on the automatic transmission fluid level indicator?	Go to <b>Step 23</b>	Go to <b>Step 31</b>
	Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust.		
20	Repair or replace the leaking component. Refer to the appropriate repair.		-
9	Condensation in the exhaust system can cause an odorless white smoke during engine warm up.	Go to <b>Step 31</b>	
21	Is the repair complete?	Go to <b>Step 31</b>	
	Replace the coolant pressure cap.		
	Does the white smoke have a burning coolant type odor?	Go to <b>Step 28</b>	Go to <b>Step 10</b>
22	Replace the heater core. Refer to <b>Heater Core Replacement</b> .		-
10	With the engine idling, inspect the surge tank system.	Go to <b>Step 31</b>	
	Is the repair complete?		
	Does the surge tank system discharge coolant while the engine is idling?	Go to <b>Step 15</b>	Go to <b>Step 11</b>
	1. Remove the transmission oil cooler.		
23	Visually inspect the radiator pipes and hose clamps at the following locations:		
	2. Pressure test the cooling system.		
	Refer to <b>Cooling System Leak Testing</b> .		
11	3. Inspect the transmission oil cooler for coolant.		
	• Surge tank.		
	• Heater core		
	Is coolant present?	Go to <b>Step 24</b>	Go to <b>Step 25</b>
	• Radiator		
	1. Replace the radiator. Refer to <b>Radiator Replacement (L26)</b> or <b>Radiator Replacement (LD8)</b> .		
	Are any of the hoses, clamps or lines leaking?	Go to <b>Step 20</b>	Go to <b>Step 11</b>
24	2. Service the automatic transmission.		-
	Visually inspect the following:		
	Refer to <b>Engine Coolant/Water in Transmission</b> for the 4T80-E transaxle or <b>Engine Coolant/Water in Transmission</b>		

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	components: 4T65-E transaxle.		
25	Is the coolant pressure cap • Coolant pressure cap Installed correctly? Install the cooling lines to the radiator. • Core plugs Is the action complete? • Cylinder head gaskets	Go to <b>Step 31</b> Go to <b>Step 31</b>	-
12 26	Repair the engine no crank condition. • Engine block Refer to <b>Engine Will Not Crank -</b> • Intake manifold <b>Crankshaft Will Not Rotate</b> for the 4.6L engine or <b>Engine Will Not Crank</b> - <b>Crankshaft Will Not Rotate</b> for the 3.8L engine. • Water pump Is the repair complete?	Go to <b>Step 31</b>	-
27	Repair the engine overheating condition. Refer to <b>Engine</b> Overheating 1. Pressure test the cooling system. Is the repair complete? Refer to <b>Cooling System Leak</b> Testing	Go to <b>Step 20</b> Go to <b>Step 31</b>	Go to <b>Step 1</b>
13 28	Repair the engine internal coolant leak. 2. With the cooling system pressurized, visually inspect the components for the 4.6L engine or <b>Coolant in</b> <b>Combustion Chamber</b> or <b>Coolant in</b> <b>Engine Oil</b> for the 3.8L engine. Are any leaks present?	Go to <b>Step 20</b> Go to <b>Step 31</b>	Go to <b>Step 1</b>
14 29	Repair the engine knock. Refer to <b>Lower Engine Noise, Regardless of</b> <b>Engine Speed</b> for the 4.6L engine or <b>Lower Engine Noise, Regardless of</b> <b>Engine Speed</b> for the 3.8L engine. Refer to <b>Pressure Cap Testing</b> . Is the repair complete? Does the coolant pressure cap hold pressure?	Go to <b>Step 16</b>	Go to <b>Step 2</b>
15	Pressure test the coolant pressure cap. Refer to <b>Pressure Cap Testing</b> . Is the repair complete? Does the coolant pressure cap hold pressure?	Go to <b>Step 31</b>	
	Repair the combustion pressure in the cooling system problem. Refer to Inspect for the following conditions: <b>Cylinder Leakage Test</b> for the 4.6L engine or <b>Cylinder Leakage Test</b> for the 3.8L engine. • Coolant in the HVAC module drain tube Is the repair complete?	Go to <b>Step 30</b> Go to <b>Step 31</b>	Go to <b>Step 2</b>
30 16	Operate the system in order to verify the repair. • Coolant on the vehicle floor covering near the HVAC module. Did you find and correct the condition?	System OK	Go to <b>Step 2</b>

## THERMOSTAT DIAGNOSIS

Tools Required



**J 24731** Tempilstick. See **Special Tools**.**Thermostat Test**

The coolant thermostat can be tested using a temperature (tempil) stick. The temperature stick is a pencil like device. It has a wax material containing certain chemicals which melt at a given temperature. Temperature sticks can be used to determine a thermostat's operating range, by rubbing 87°C (188°F) and 97°C (206°F) sticks on the thermostat housing.

1. Use a tempilstick in order to find the opening and the closing temperatures of the coolant thermostat.
  - **J 24731** -188 tempilstick melts at 87°C (188°F). See **Special Tools**. The thermostat should begin to open.
  - **J 24731** -206 tempilstick melts at 97°C (206°F). See **Special Tools**. The thermostat should be fully open.
2. Replace the coolant thermostat if it does not operate properly between this temperature range. Refer to **Engine Coolant Thermostat Replacement (L26)** or **Engine Coolant Thermostat Replacement (LD8)**.

**COOLANT HEATER INOPERATIVE****Coolant Heater Inoperative**

Step	Action	Yes	No
DEFINITION: The coolant heater does not warm the engine coolant properly.			
1	Did you perform the necessary inspections?	Go to <b>Step 2</b>	Go to <b><u>Symptoms - Engine Cooling</u></b>
2	Test the engine coolant heater power supply cord for an open or short to ground. Refer to <b><u>Circuit Testing</u></b> . Did you find a condition?	Go to <b>Step 3</b>	Go to <b>Step 4</b>
3	Replace the engine coolant heater power supply cord. Refer to <b><u>Coolant Heater Cord Replacement (RPO L26)</u></b> or <b><u>Coolant Heater Cord Replacement (LD8)</u></b> . Did you complete the replacement?	Go to <b>Step 6</b>	-
4	Inspect for poor connections at the harness connector of the engine coolant heater. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and <b><u>Connector Repairs</u></b> .		

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	Did you find and correct the condition?	Go to <b>Step 6</b>	Go to <b>Step 5</b>
5	Replace the engine coolant heater. Refer to <b><u>Engine Coolant Heater Replacement - Left Side (RPO LD8)</u></b> or <b><u>Engine Coolant Heater Replacement - Right Side (RPO LD8)</u></b> . Did you complete the replacement?	Go to <b>Step 6</b>	-
6	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 2</b>

**ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE****Engine Fails To Reach Normal Operating Temperature**

Step	Action	Yes	No
1	Check the level of the coolant in the coolant surge tank. Is the coolant in the surge tank at the proper level?	Go to <b>Step 3</b>	Go to <b>Step 2</b>
2	Add engine coolant as necessary. Refer to <b><u>Cooling System Draining and Filling (Static Fill)</u></b> or <b><u>Cooling System Draining and Filling (Vac-N-Fill)</u></b> . Does the engine still fail to reach normal operating temperature?	Go to <b>Step 3</b>	System OK
3	Check if the thermostat is stuck open. Is the thermostat stuck in the open position?	Go to <b>Step 5</b>	Go to <b>Step 4</b>
4	Check to see if the correct type of thermostat was installed. Was the incorrect thermostat installed?	Go to <b>Step 5</b>	System OK
5	Replace the thermostat. Refer to <b><u>Engine Coolant Thermostat Replacement (L26)</u></b> or <b><u>Engine Coolant Thermostat Replacement (LD8)</u></b> . Does the engine still fail to reach normal operating temperature?	-	System OK

**PRESSURE CAP TESTING**

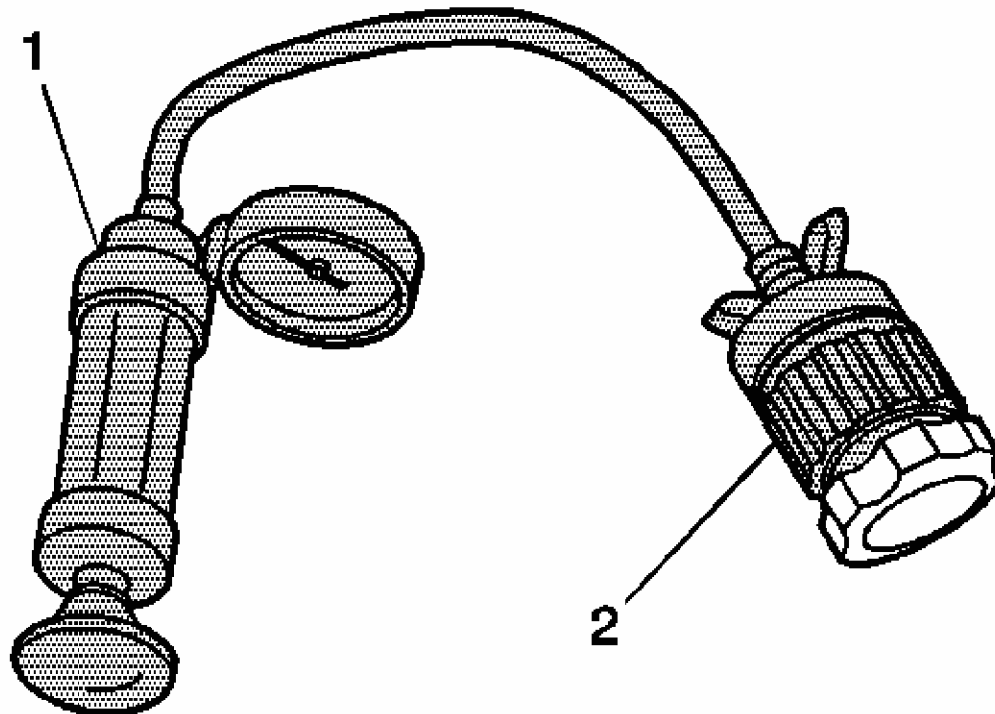
Tools Required

- **J 24460-01** Cooling System Pressure Tester. See Special Tools.
- **J 42401** Radiator Cap/Surge Tank Test Adapter. See Special Tools.

**Test Procedure**

**CAUTION:** To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

1. Remove the pressure cap.
2. Wash the pressure cap sealing surface with water.



**Fig. 5: Pressure Testing Radiator Cap**  
Courtesy of GENERAL MOTORS CORP.

3. Use the **J 24460-01** (1) with **J 42401** (2) in order to test the pressure cap. See Special Tools.

4. Test the pressure cap for the following conditions:

- Pressure release when the **J 24460-01** exceeds the pressure rating of the pressure cap. See **Special Tools**.
- Maintain the rated pressure for at least 10 seconds.

Note the rate of pressure loss.

5. Replace the pressure cap under the following conditions:

- The pressure cap does not release pressure which exceeds the rated pressure of the cap.
- The pressure cap does not hold the rated pressure.

## **COOLING SYSTEM LEAK TESTING**

### **Tools Required**

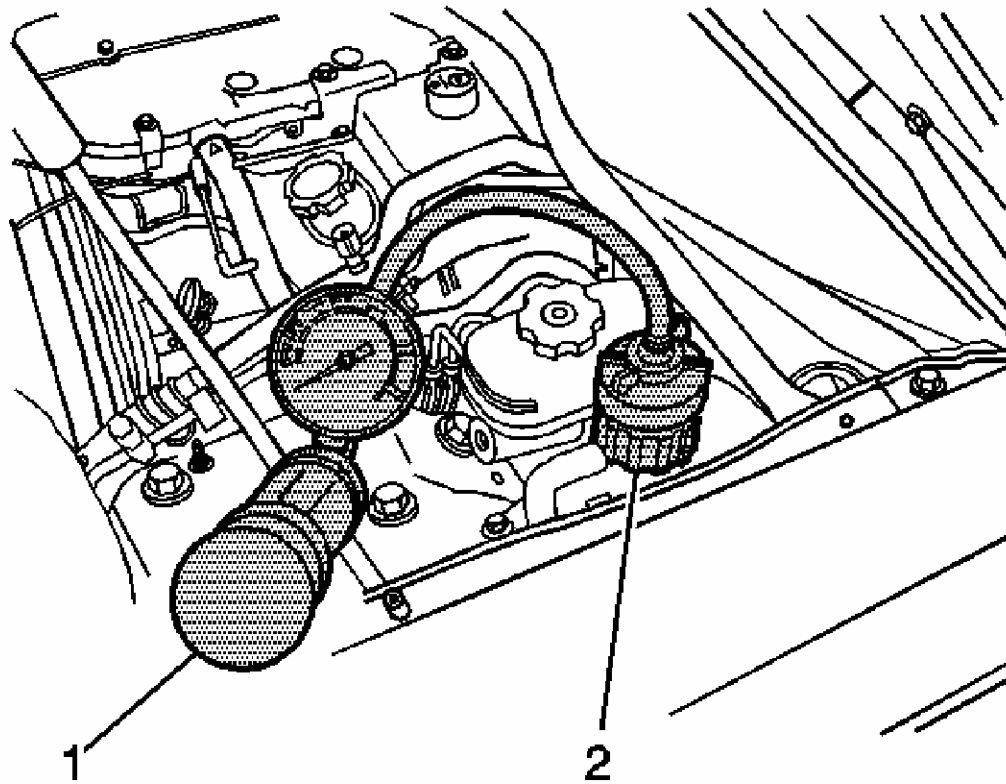
- **J 24460-01** Cooling System Pressure Tester. See **Special Tools**.
- **J 42401** Radiator Cap/Surge Tank Test Adapter. See **Special Tools**.

### **Test Procedure**

**CAUTION:** Under pressure, the temperature of the solution in the radiator can be considerably higher, without boiling. Removing the radiator cap while the engine is hot (pressure is high), will cause the solution to boil instantaneously, with explosive force. The solution will spew out over the engine, fenders and the person removing the cap. Serious bodily injury may result. Flammable antifreeze, such as alcohol, is not recommended for use at any time. Flammable antifreeze could cause a serious fire.

**CAUTION:** In order to help avoid being burned, do not remove the radiator cap while the engine and the radiator are hot. Scalding fluid and steam can be blown out under pressure if the cap is removed too soon.

1. Remove the pressure cap.
2. Test the operation of the pressure cap. Refer to **Pressure Cap Testing**.
3. Wash the pressure cap mating surface with water.



**Fig. 6: Applying Pressure To Cooling System**  
**Courtesy of GENERAL MOTORS CORP.**

4. Use the **J 24460-01** (1) with **J 42401** (2) in order to apply pressure to the cooling system. See **Special Tools**.

Do not exceed the pressure cap rating.

5. The cooling system should hold the rated pressure for at least 2 minutes.

Observe the gage for any pressure loss.

6. Repair any leaks as required.

## **REPAIR INSTRUCTIONS**

### **COOLING SYSTEM DRAINING AND FILLING (STATIC FILL)**

#### **Tools Required**

- **J 26568** Coolant and Battery Fluid Tester. See Special Tools.
- **J 38185** Hose Clamp Pliers

**Draining Procedure**

**CAUTION:** To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

**IMPORTANT:** Do not use coolant system sealers in this cooling system.

1. Park the vehicle on a level surface.
2. Remove the surge tank cap.
3. Remove the air box. Refer to Air Cleaner Assembly Replacement .
4. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
5. Remove the air deflector. Refer to Front Air Deflector Replacement .
6. Lower the vehicle.
7. Place a drain pan under the lower radiator hose connection.
8. Using the **J 38185** reposition the lower radiator hose clamp away from the radiator.
9. Slowly remove the lower radiator hose. Drain the coolant into the drain pan.
10. Inspect the engine coolant for the following conditions:
  - Discolored appearance-Follow the flush procedure. Refer to Flushing.
  - Normal in appearance-Follow the filling procedure.

**Filling Procedure**

**NOTE:** The procedure below must be followed. Improper coolant level could result in a low or high coolant level condition, causing engine damage.

1. Install the lower radiator hose.
2. Using the **J 38185** reposition the lower radiator hose clamp to the radiator.
3. Lower the vehicle.
4. Slowly add a mixture of 50/50 DEX-COOL antifreeze and deionized water to the cooling system through the top of the surge tank opening. Refer to Approximate Fluid Capacities .
5. Fill the surge tank to the FULL COLD level.

6. Install the surge tank cap.
7. Idle the engine for 2 minutes and occasionally raise the throttle to 3,000-3,500 RPM.
8. Turn off the engine and allow the engine to cool.
9. Repeat the steps 3-7.
10. Install the air deflector. Refer to **Front Air Deflector Replacement** .
11. Install the air box. Refer to **Air Cleaner Assembly Replacement** .
12. Allow the engine to cool.
13. Remove the surge tank cap and fill to the FULL COLD level.
14. Use the **J 26568** to inspect the concentration of the engine coolant. See **Special Tools**.
15. Rinse away any excess coolant from the engine and the engine compartment.

#### **COOLING SYSTEM DRAINING AND FILLING (VAC-N-FILL)**

##### **Tools Required**

- **J 26568** Coolant and Battery Fluid Tester. See **Special Tools**.
- **J 38185** Hose Clamp Pliers
- **J 42401** Radiator Cap and Surge Tank Test Adapter. See **Special Tools**.
- **GE-47716** Vac N Fill Coolant Refill Tool. See **Special Tools**.

##### **Draining Procedure**

**CAUTION:** To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

**IMPORTANT:** Do not use coolant system sealers in this cooling system.

1. Park the vehicle on a level surface.
2. Remove the surge tank cap.
3. Remove the air box. Refer to **Air Cleaner Assembly Replacement** .
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Remove the air deflector. Refer to **Front Air Deflector Replacement** .
6. Lower the vehicle.
7. Place a drain pan under the lower radiator hose connection.
8. Using the **J 38185** reposition the lower radiator hose clamp away from the radiator.
9. Slowly remove the lower radiator hose and drain the coolant into the drain pan.

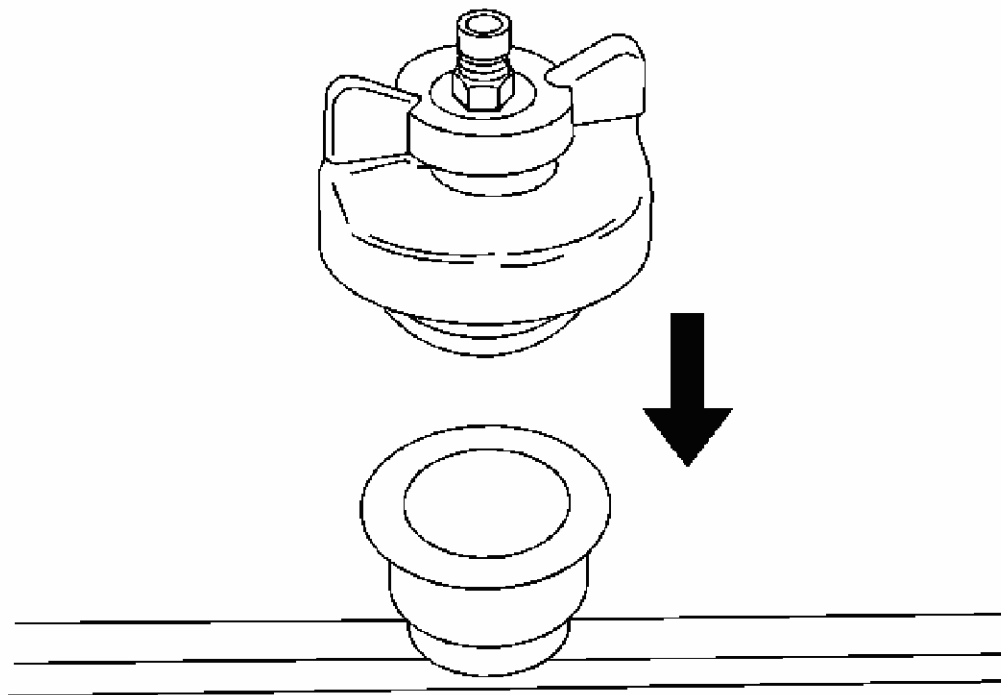
10. Inspect the engine coolant for the following conditions:

- Discolored appearance-Follow the flush procedure. Refer to **Flushing**.
- Normal in appearance-Follow the filling procedure.

**Vac-N-Fill Procedure**

**IMPORTANT:** To prevent the boiling of the coolant/water mixture in the vehicle's cooling system, do not apply vacuum to a cooling system above 49°C (120°F). The tool will not operate properly when the coolant is boiling

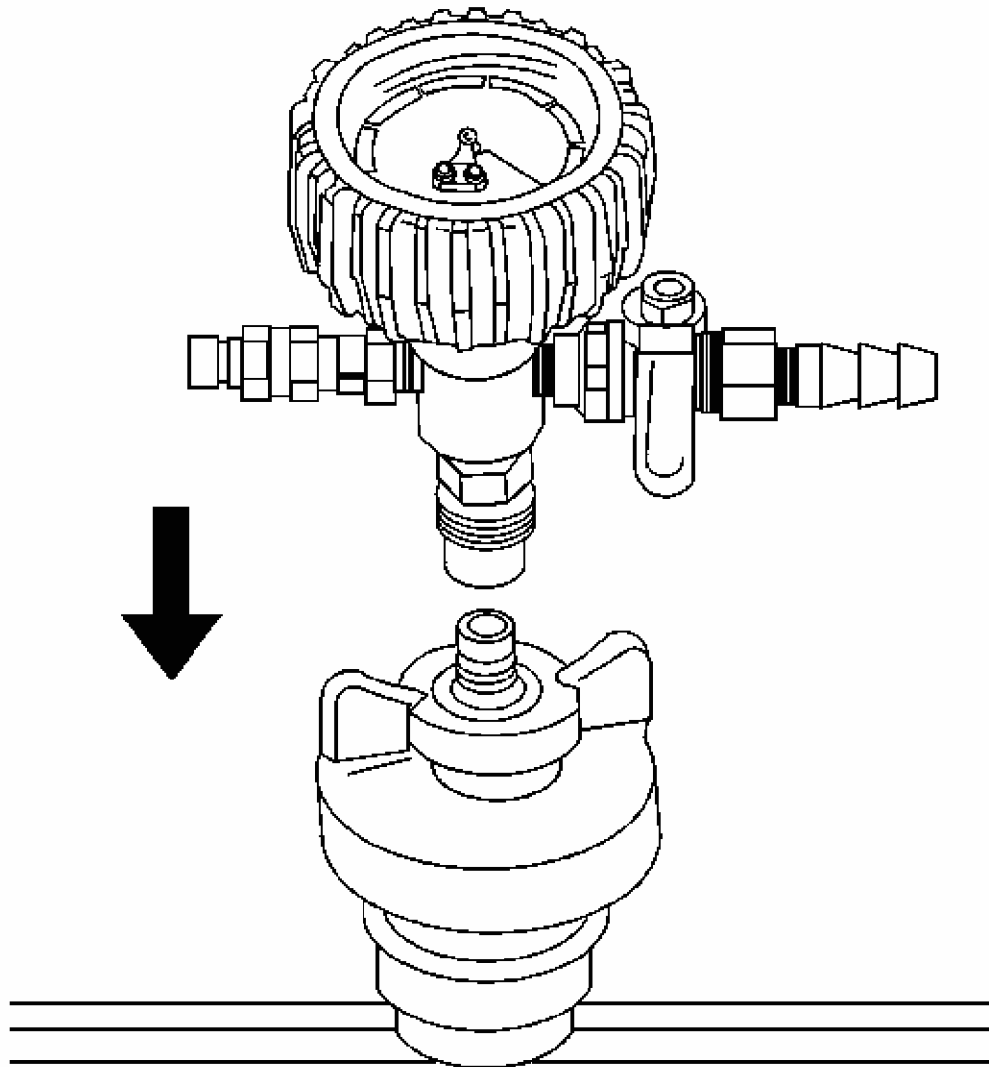
1. Install the **J 42401** onto the coolant surge tank. See **Special Tools**.



**Fig. 7: Attaching Van-N-Fill Cap To Vehicles Coolant Fill Port**  
**Courtesy of GENERAL MOTORS CORP.**

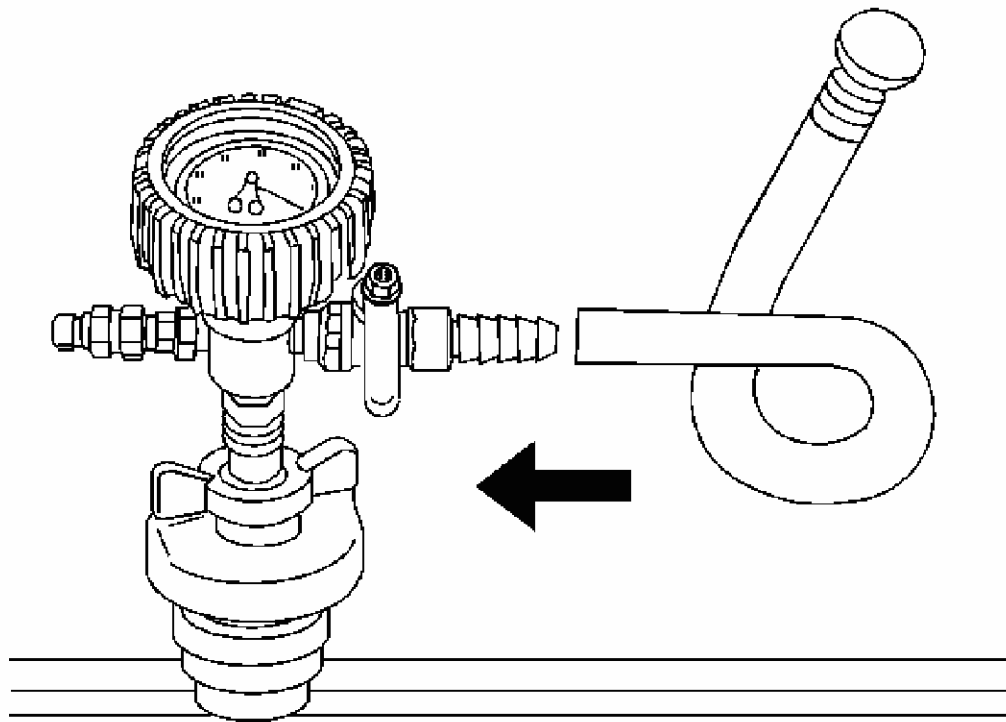
2. Attach the Vac N Fill cap to the vehicle's coolant fill port.





**Fig. 8: Attaching The Vacuum Gage Assembly To The Vac N Fill Cap**  
**Courtesy of GENERAL MOTORS CORP.**

3. Attach the vacuum gage assembly to the Vac N Fill cap.

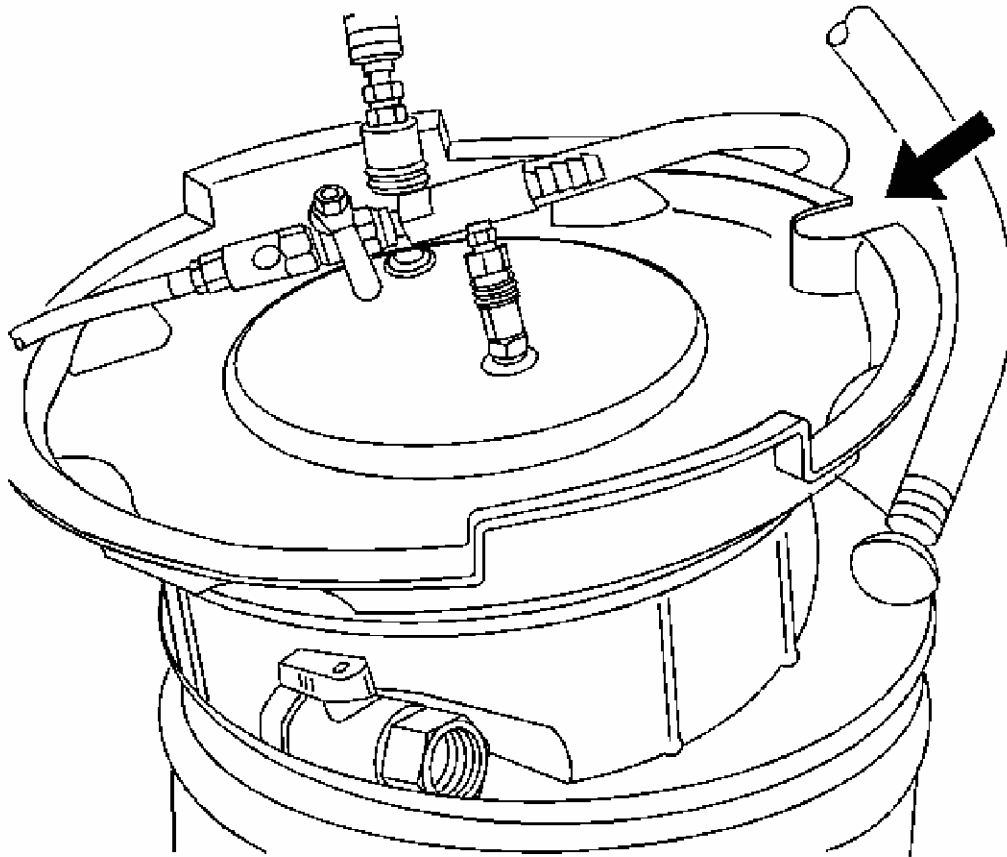


**Fig. 9: Attaching The Fill Hose To The Barb Fitting On The Vacuum Gage Assembly**

**Courtesy of GENERAL MOTORS CORP.**

4. Attach the fill hose to the barb fitting on the vacuum gage assembly.

Ensure that the valve is closed.



**Fig. 10: Identifying Graduated Reservoir**  
**Courtesy of GENERAL MOTORS CORP.**

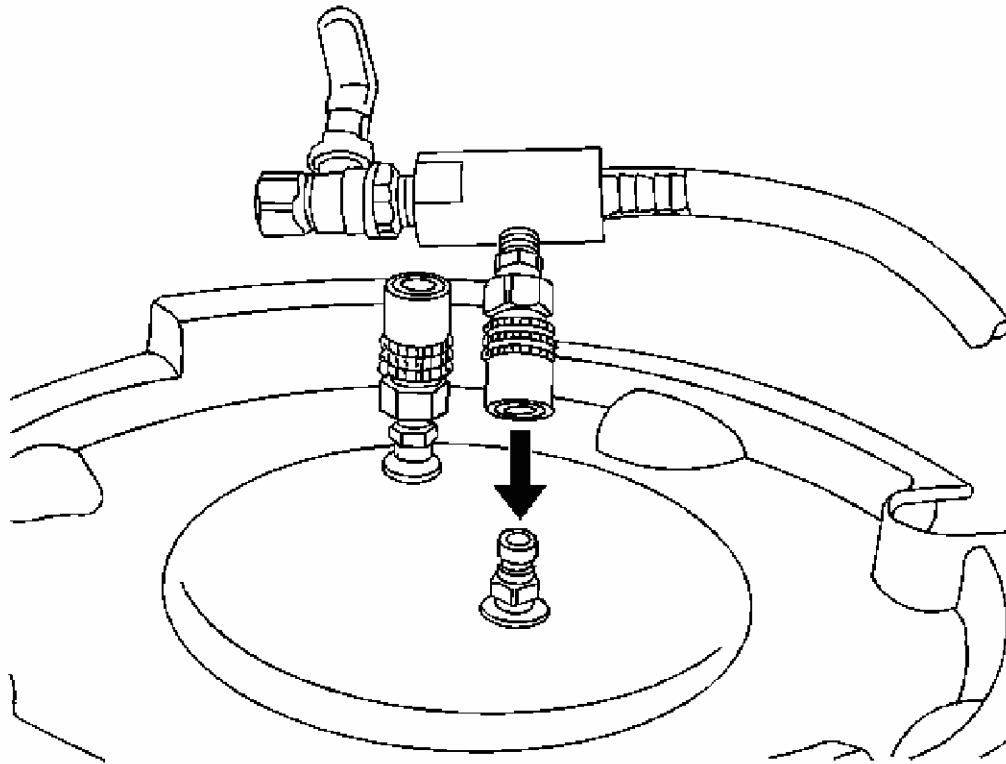
**IMPORTANT:** Use a 50/50 mixture of DEX-COOL antifreeze and clean, drinkable water.  
Always use more coolant than necessary. This will eliminate air from being drawn into the cooling system.

5. Pour the coolant mixture into the graduated reservoir.
6. Place the fill hose in the graduated reservoir.

**IMPORTANT:** Prior to installing the vacuum tank onto the graduated reservoir, ensure that the drain valve located on the bottom of the tank is closed.

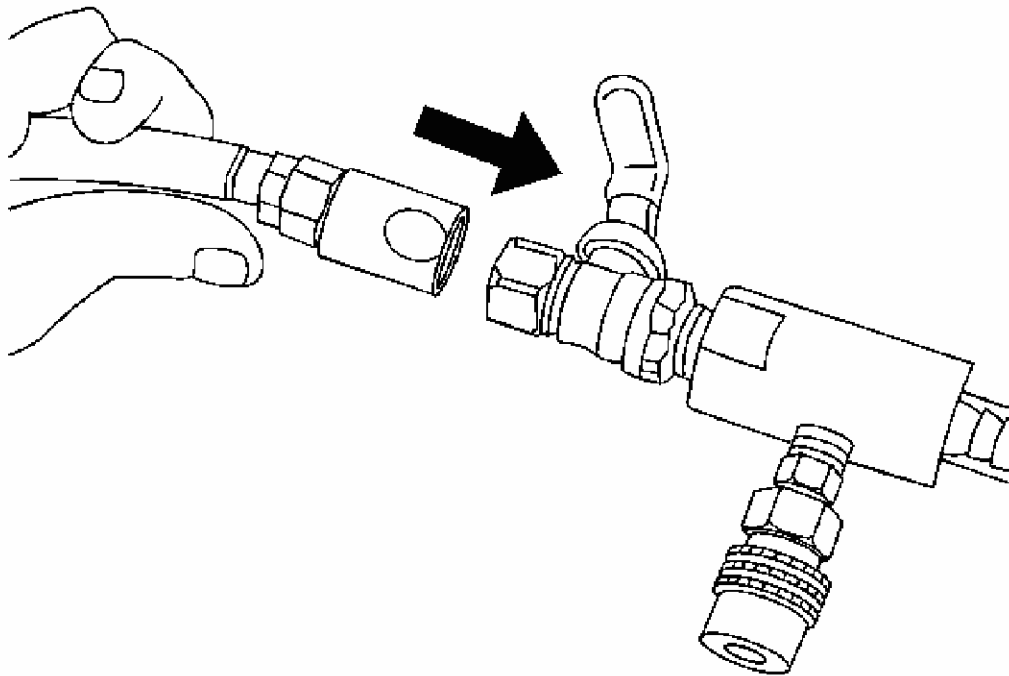
7. Install the vacuum tank on the graduated reservoir with the fill hose routed through the

cut-out area in the vacuum tank.



**Fig. 11: Attaching Venturi Assembly To Vacuum Tank**  
**Courtesy of GENERAL MOTORS CORP.**

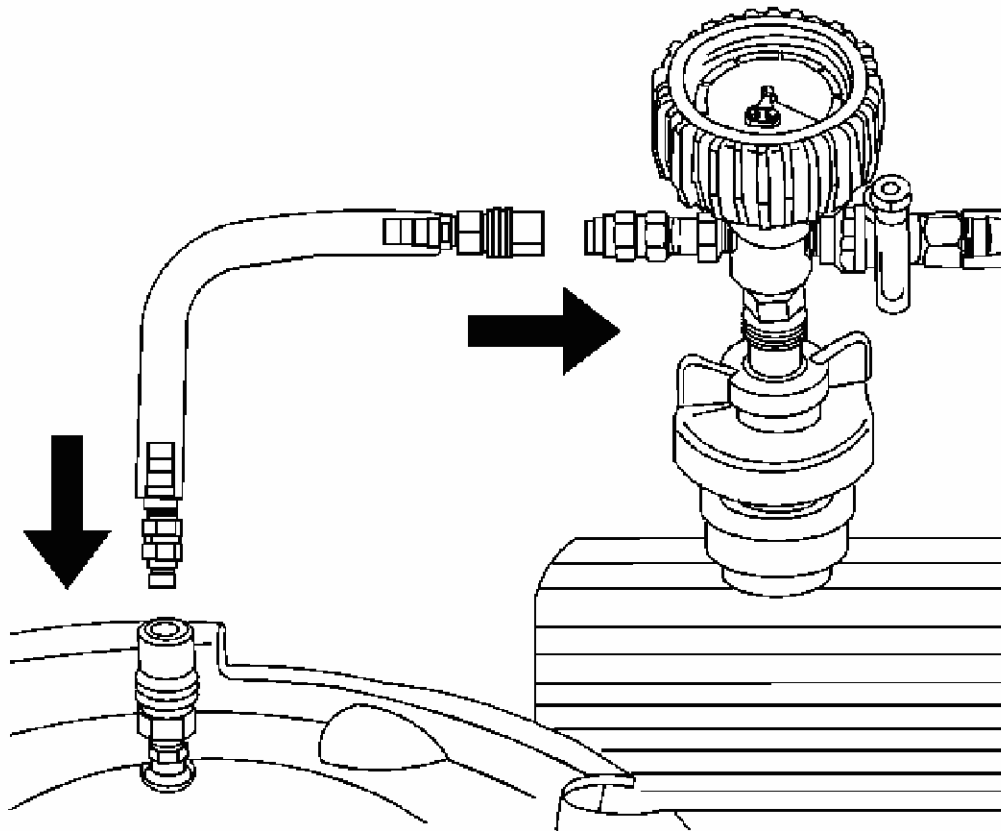
8. Attach the venturi assembly to the vacuum tank.



**Fig. 12: Attaching A Shop Air Hose To The Venturi Assembly**  
**Courtesy of GENERAL MOTORS CORP.**

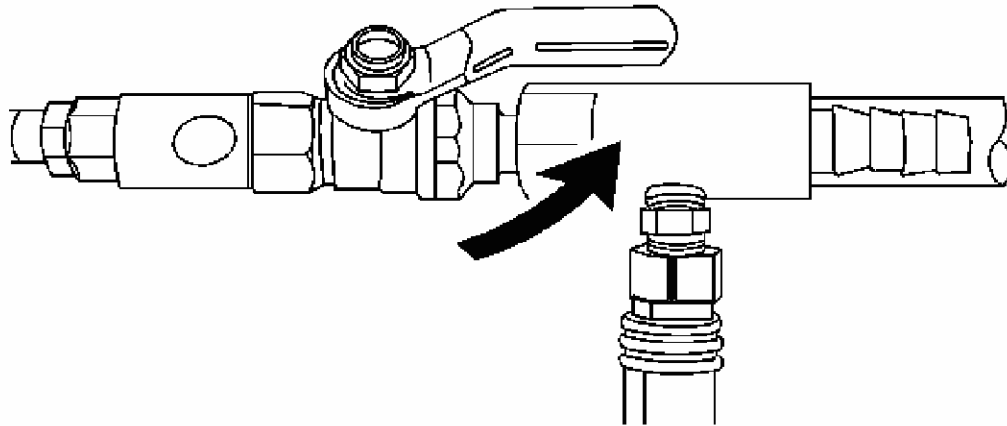
9. Attach a shop air hose to the venturi assembly.

Ensure the valve on the venturi assembly is closed.



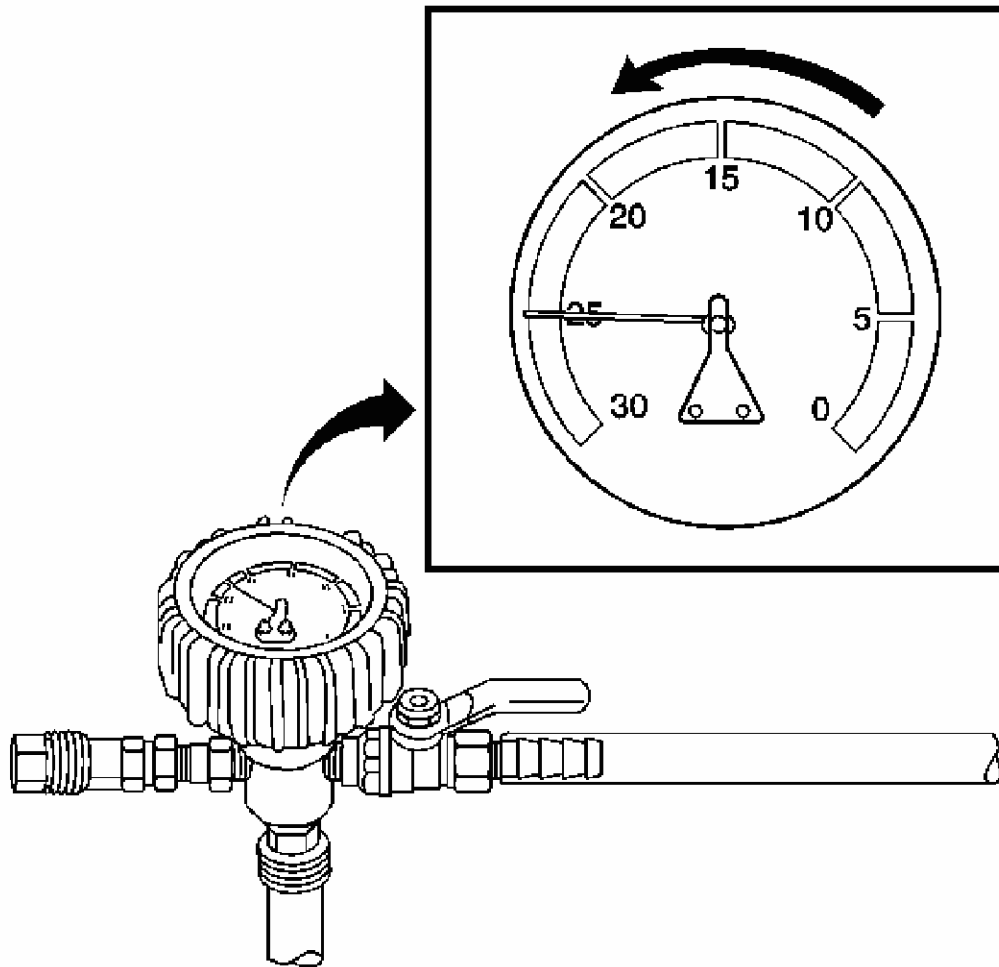
**Fig. 13: Attaching Vacuum Hose To Vacuum Gauge Assembly & Vacuum Tank**  
**Courtesy of GENERAL MOTORS CORP.**

10. Attach the vacuum hose to the vacuum gage assembly and the vacuum tank.
11. Clamp the overflow hose closed.



**Fig. 14: Identifying Valve & Venturi Assembly**  
**Courtesy of GENERAL MOTORS CORP.**

12. Open the valve on the venturi assembly. The vacuum gage will begin to rise and a hissing noise will be present.



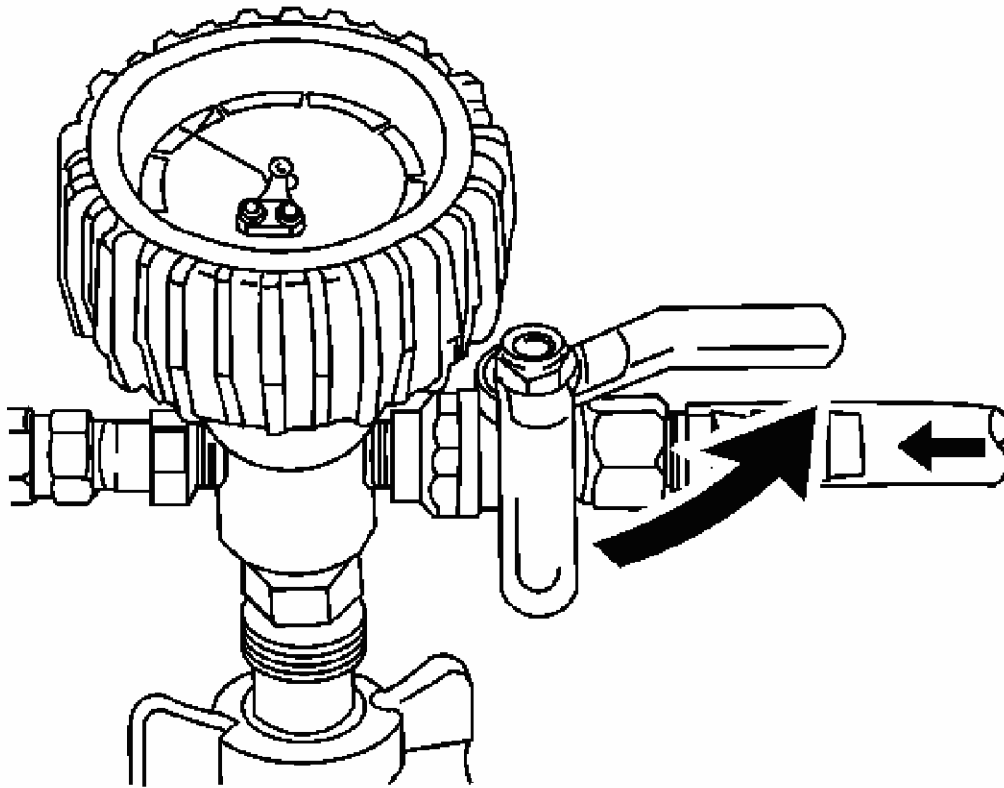
**Fig. 15: Continuing To Draw Vacuum Until The Needle Stops Rising**  
**Courtesy of GENERAL MOTORS CORP.**

13. Continue to draw vacuum until the needle stops rising. This should be 610-660 mm Hg (24-26 in Hg).

Cooling hoses may start to collapse. This is normal due to vacuum draw.

14. To aid in the fill process, position the graduated reservoir above the coolant fill port.



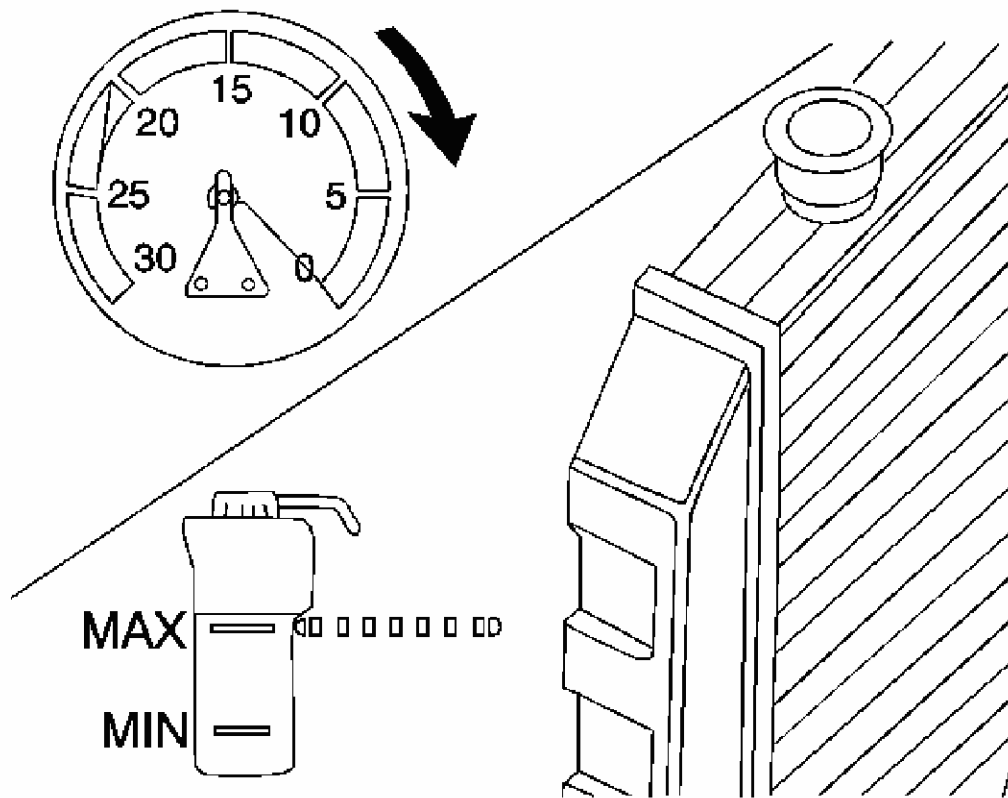


**Fig. 16: Slowly Opening The Valve On The Vacuum Gage Assembly**  
**Courtesy of GENERAL MOTORS CORP.**

15. Slowly open the valve on the vacuum gage assembly. When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose.
16. Close the valve on the venturi assembly.
17. If there is a suspected leak in the cooling system, allow the system to stabilize under vacuum. Monitor for vacuum loss.

If vacuum loss is observed, refer to **Loss of Coolant**.

18. Open the valve on the vacuum gage assembly. The vacuum gage will drop as coolant is drawn into the system.

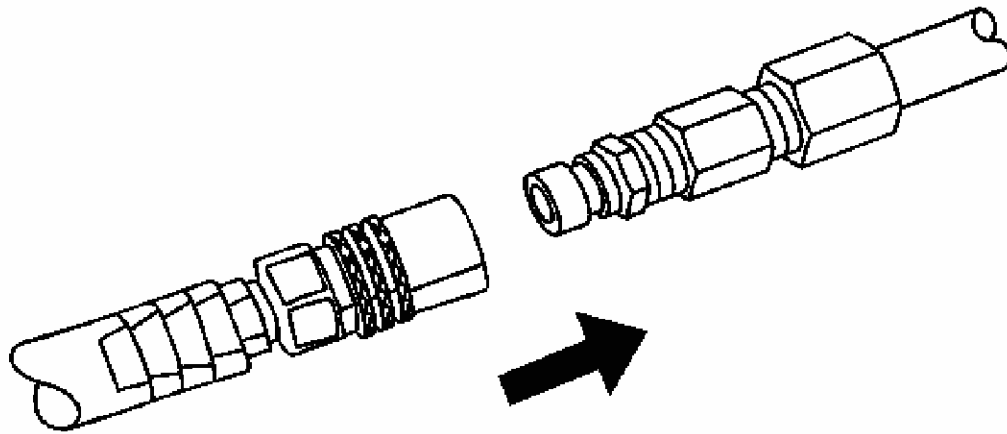


**Fig. 17: View Of Vacuum Gauge & Radiator**  
Courtesy of GENERAL MOTORS CORP.

19. Once the vacuum gage reaches zero, close the valve on the vacuum gage assembly and repeat steps 12-18.
20. Detach the Vac N Fill cap from the vehicle's coolant fill port.
21. Remove the **J 42401** from the coolant surge tank. See **Special Tools**.
22. Add coolant to the system as necessary.
23. Use the **J 26568** to inspect the concentration of the coolant mixture using. See **Special Tools**.

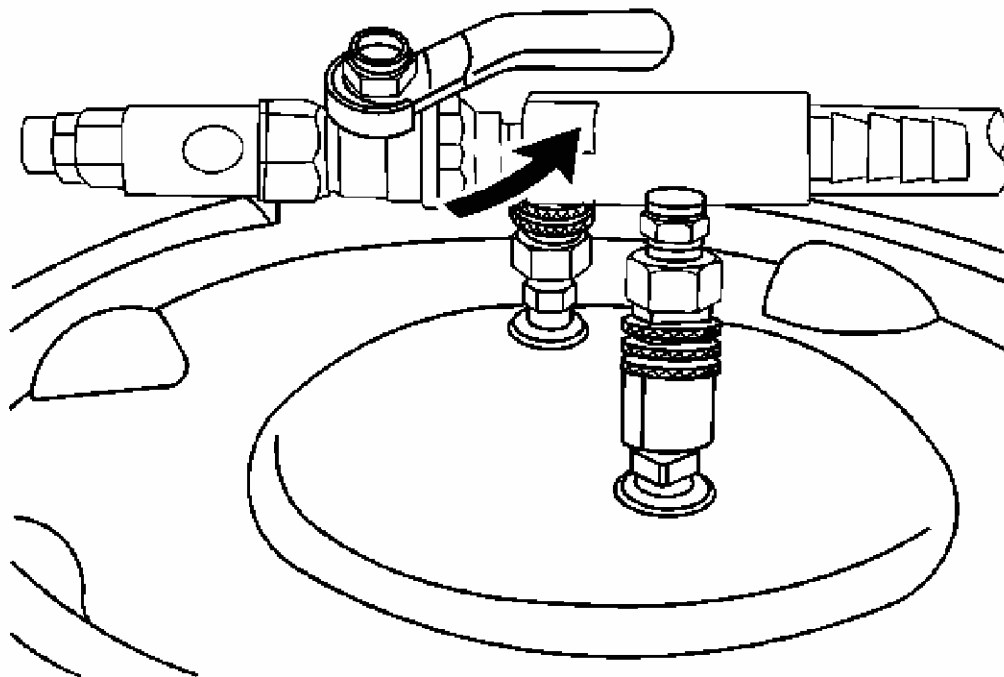
**IMPORTANT:** After filling the cooling system, the extraction hose can be used to remove excess coolant to achieve the proper coolant level.

24. Detach the vacuum hose from the vacuum gage assembly.



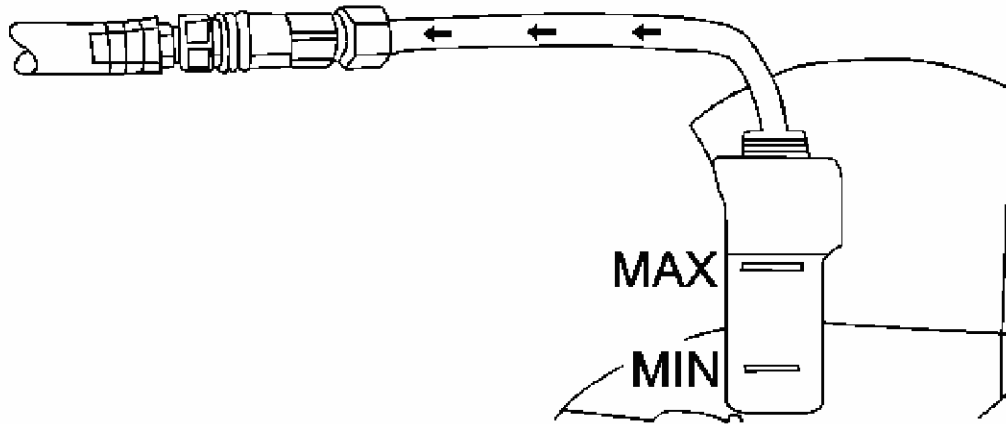
**Fig. 18: Attaching Extraction Hose To Vacuum Hose**  
**Courtesy of GENERAL MOTORS CORP.**

25. Attach the extraction hose to the vacuum hose.



**Fig. 19: Opening Valve On Venturi Assembly**  
**Courtesy of GENERAL MOTORS CORP.**

26. Open the valve on the venturi assembly to start a vacuum draw.



**Fig. 20: Drawing Out Coolant To The Proper Level**  
**Courtesy of GENERAL MOTORS CORP.**

27. Use the extraction hose to draw out coolant to the proper level.  
28. The vacuum tank has a drain valve on the bottom of the tank. Open the valve to drain coolant from the vacuum tank into a suitable container for disposal.  
29. Install the surge tank cap.

## **FLUSHING**

**IMPORTANT: The thermostat should be removed before flushing the system.**

Various methods and equipment may be used to flush the system. If using special equipment such as a back flusher, follow the manufacturer's instructions.

## **RADIATOR CLEANING**

**CAUTION: NEVER spray water on a hot radiator. The resulting steam could cause personal injury.**

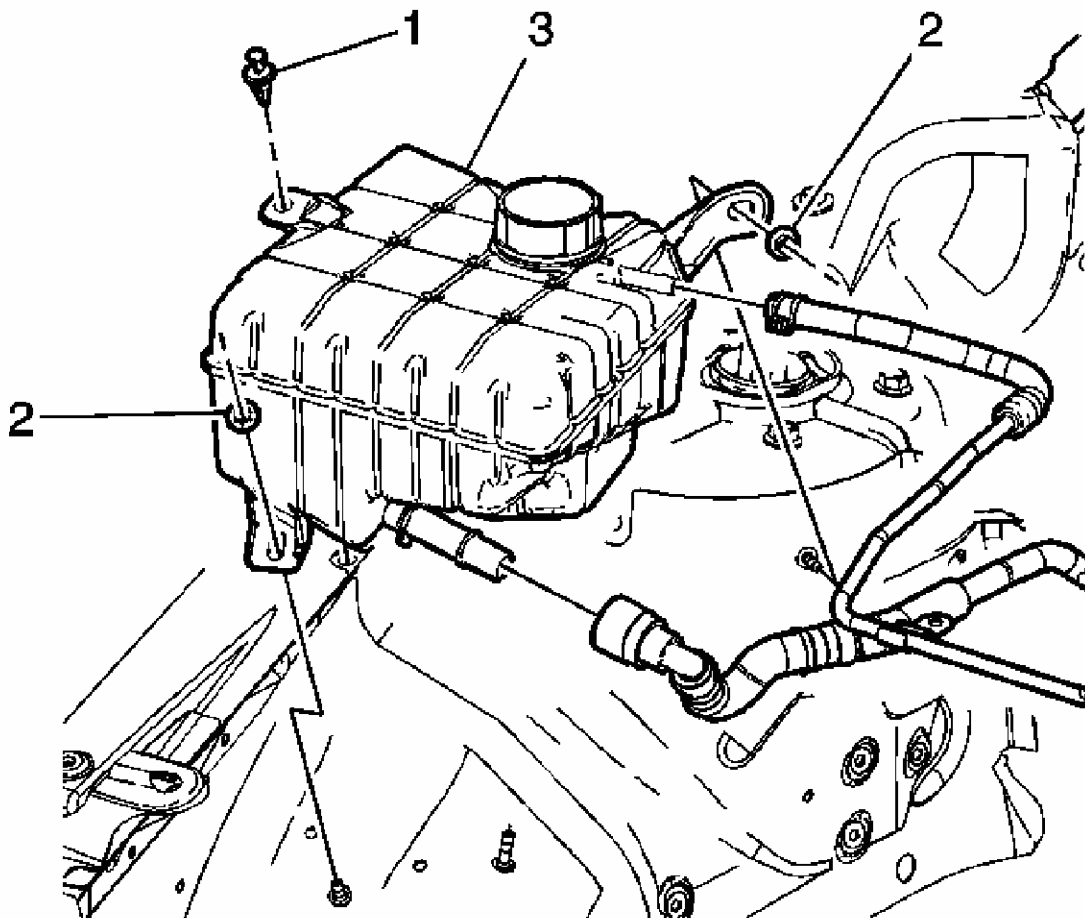
**NOTE:** The radiator fins are necessary for good heat transfer. Do not brush the fins. This may cause damage to the fins, reducing heat

transfer.

**IMPORTANT:** Remove bugs, leaves, dirt and other debris by blowing compressed air through the engine side of the radiator.

- Some conditions may require the use of warm water and a mild detergent.
- Clean the A/C condenser fins.
- Clean between the A/C condenser and radiator.
- Clean the radiator cooling fins.
- Straighten any damaged cooling fins.

#### RADIATOR SURGE TANK REPLACEMENT (LD8)



**Fig. 21: View Of Radiator Surge Tank & Attachments**  
Courtesy of GENERAL MOTORS CORP.

#### Radiator Surge Tank Replacement (LD8)

Callout	Component Name

**NOTE:**

Refer to Fastener Notice .

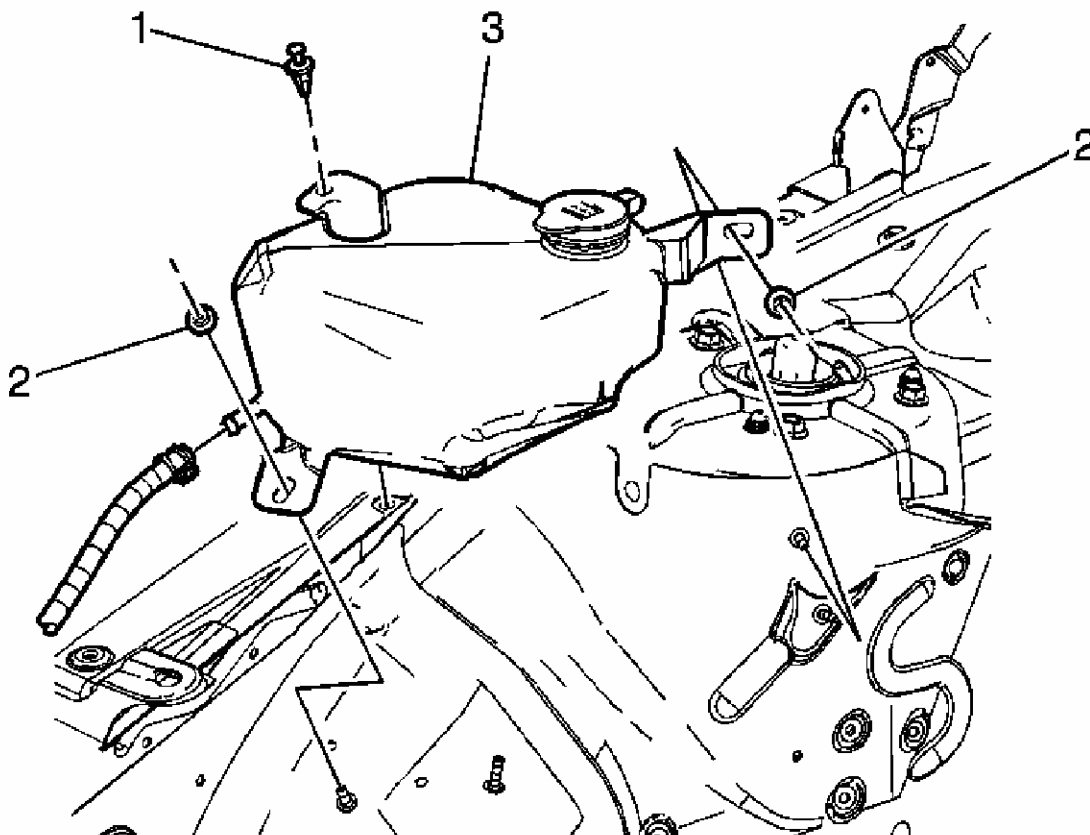
**Fastener Tightening Specifications:** Refer to Fastener Tightening Specifications. **Preliminary Procedure:**

**IMPORTANT:**

Drain only the fluid from the radiator surge tank.

Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill) or Cooling System Draining and Filling (Vac-N-Fill).

1	Push Pin Retainer <b>Tip:</b> Using <b>J 38185</b> Hose Clamp Pliers position the radiator surge tank hose clamp aside and remove the hose from the radiator surge tank.
2	Surge Tank Retaining Nut <b>Tighten:</b> 9 N.m (53 lb in)
3	Radiator Surge Tank Assembly

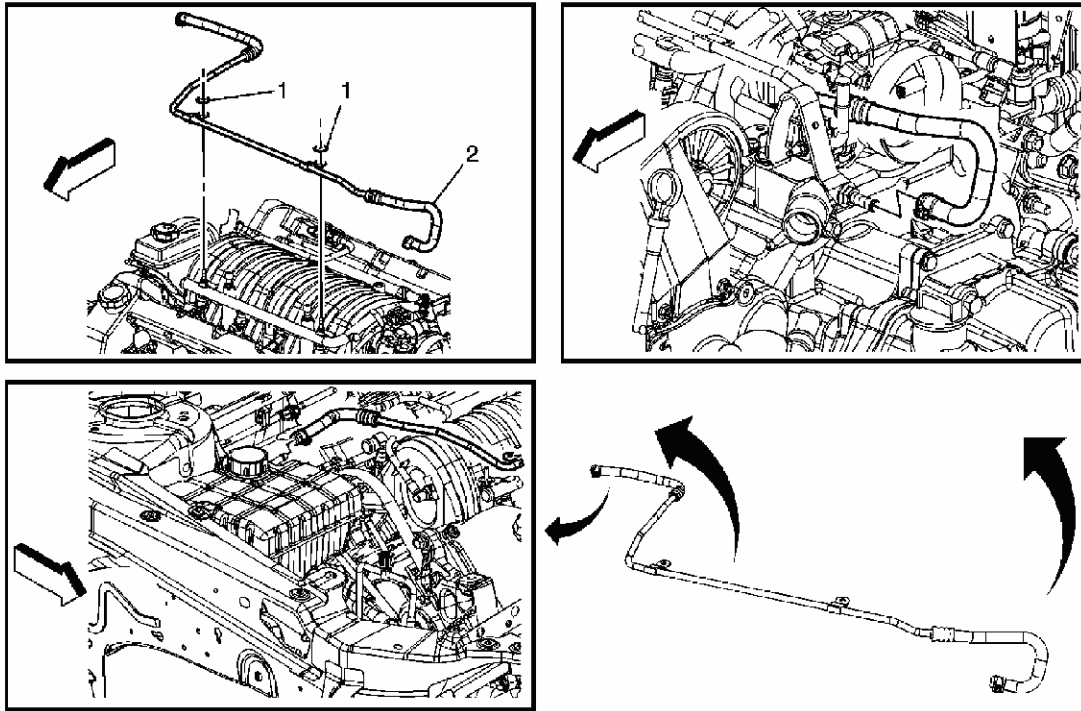
**COOLANT RECOVERY RESERVOIR REPLACEMENT**

**Fig. 22: View Of Coolant Recovery Reservoir**  
**Courtesy of GENERAL MOTORS CORP.**

### Coolant Recovery Reservoir Replacement

Callout	Component Name
<p><b>NOTE:</b>  Refer to <u>Fastener Notice</u> .</p> <p><b>Fastener Tightening Specifications:</b> Refer to <u>Fastener Tightening Specifications</u>. <b>Preliminary Procedure:</b></p> <p><b>IMPORTANT:</b>  Drain only the fluid from the coolant recovery reservoir.</p> <p>Drain the cooling system. Refer to <u>Cooling System Draining and Filling (Static Fill)</u> or <u>Cooling System Draining and Filling (Vac-N-Fill)</u>.</p>	
1	Push Pin Retainer <b>Tip:</b> Using <b>J 38185</b> Hose Clamp Pliers position the coolant recovery reservoir hose clamp aside and remove the hose from the reservoir.
2	Coolant Recovery Reservoir Nut (Qty: 2) <b>Tighten:</b> 9 N.m (53 lb in)
3	Coolant Recovery Reservoir

### RADIATOR SURGE TANK INLET HOSE/PIPE REPLACEMENT (LD8)



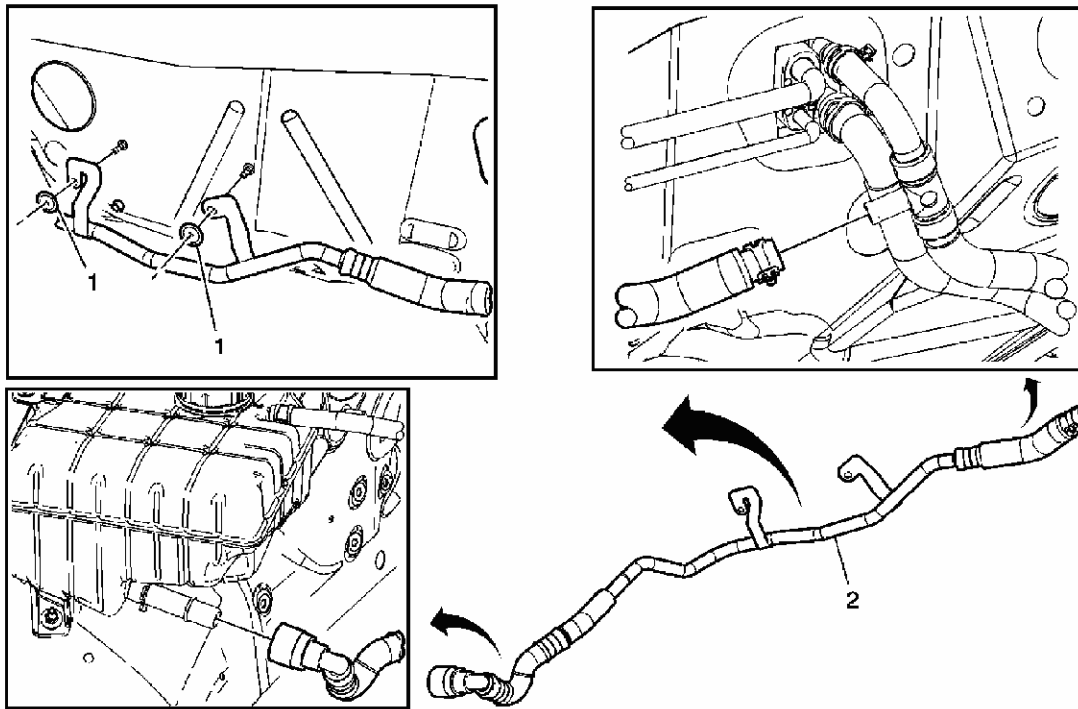
**Fig. 23: Identifying Radiator Surge Tank Inlet Hose/Pipe (LD8)**  
 Courtesy of GENERAL MOTORS CORP.

### Radiator Surge Tank Inlet Hose/Pipe Replacement (LD8)

Callout	Component Name
<b>Fastener Tightening Specifications:</b> Refer to <u>Fastener Tightening Specifications</u> .	
<b>Preliminary Procedure</b>	
<b>IMPORTANT:</b> Drain only the fluid from the radiator surge tank.	
1. Drain the cooling system. Refer to <u>Cooling System Draining and Filling (Static Fill)</u> or <u>Cooling System Draining and Filling (Vac-N-Fill)</u> . 2. Remove the fuel injector sight shield. Refer to <u>Fuel Injector Sight Shield Replacement</u> .	
1	Radiator Surge Tank Inlet Pipe Nuts (Qty: 2) <b>Tip:</b> Using <b>J 38185</b> Hose Clamp Pliers position the radiator surge tank hose clamps aside and remove the hose from the radiator surge tank and engine.
2	Radiator Surge Tank Inlet Pipe Assembly

### RADIATOR SURGE TANK OUTLET HOSE/PIPE REPLACEMENT (LD8)



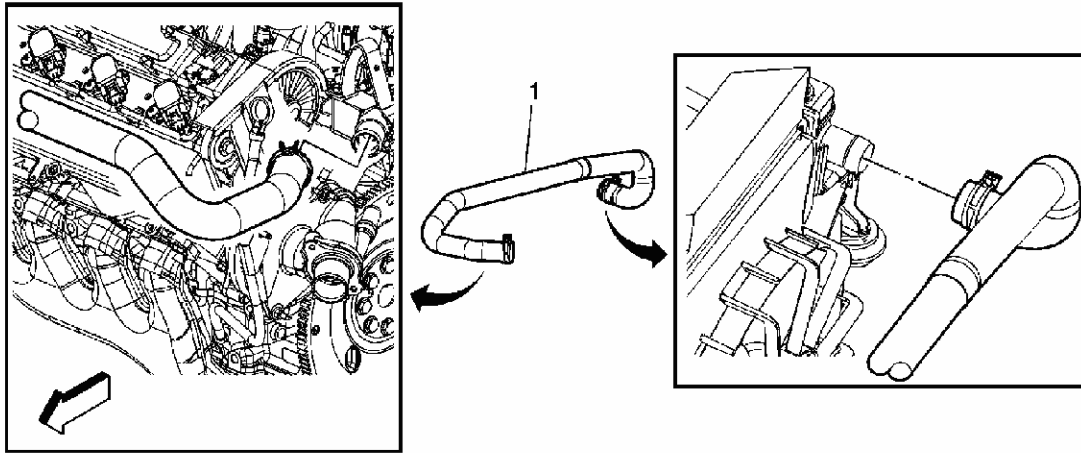


**Fig. 24: View Of Surge Tank Outlet Hose/Pipe**  
 Courtesy of GENERAL MOTORS CORP.

### Radiator Surge Tank Outlet Hose/Pipe Replacement (LD8)

Callout	Component Name
<b>Fastener Tightening Specifications:</b> Refer to <u>Fastener Tightening Specifications</u> .	
<b>Preliminary Procedure</b>	
<b>IMPORTANT:</b> Drain only the fluid from the radiator surge tank.	
1. Drain the cooling system. Refer to <u>Cooling System Draining and Filling (Static Fill)</u> or <u>Cooling System Draining and Filling (Vac-N-Fill)</u> . 2. Remove the fuel injector sight shield. Refer to <u>Fuel Injector Sight Shield Replacement</u> .	
1	Radiator Surge Tank Outlet Pipe Nuts (Qty: 2) <b>Tip:</b> Using <b>J 38185</b> Hose Clamp Pliers position the radiator surge tank hose clamp aside and remove the hose from the radiator surge tank and heater hose.
2	Radiator Surge Tank Outlet Pipe Assembly

### RADIATOR INLET HOSE REPLACEMENT (LD8)

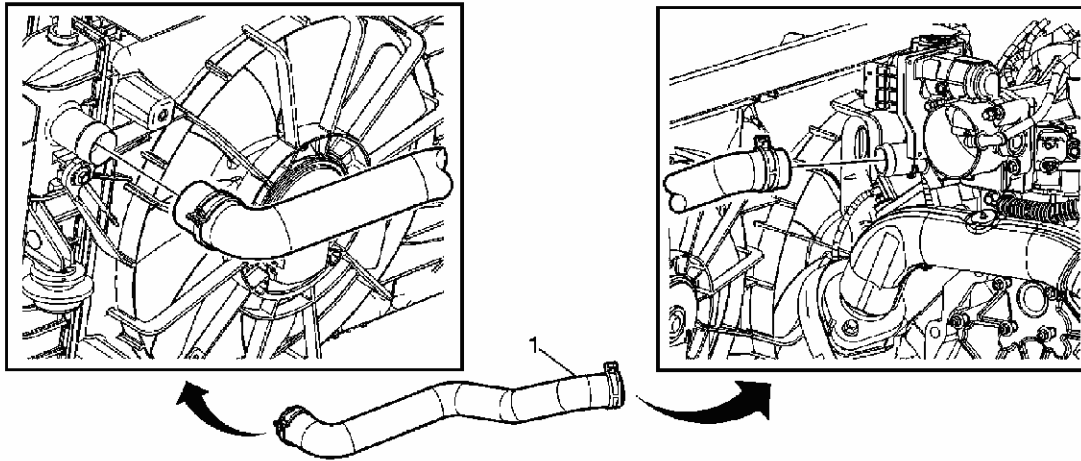


**Fig. 25: View Of Radiator Inlet Hose (LD8)**  
Courtesy of GENERAL MOTORS CORP.

### Radiator Inlet Hose Replacement (LD8)

Callout	Component Name
<b>Fastener Tightening Specifications:</b> Refer to <u>Fastener Tightening Specifications</u> .	
<b>Preliminary Procedure:</b>	
<b>IMPORTANT:</b> Drain only the fluid from the radiator surge tank.	
Drain the cooling system. Refer to <u>Cooling System Draining and Filling (Static Fill)</u> or <u>Cooling System Draining and Filling (Vac-N-Fill)</u> .	
1	Radiator Inlet Hose <b>Tip:</b> Using <b>J 38185</b> Hose Clamp Pliers position the radiator inlet hose clamps aside and remove the hose from the radiator and engine.

### RADIATOR INLET HOSE REPLACEMENT (L26)

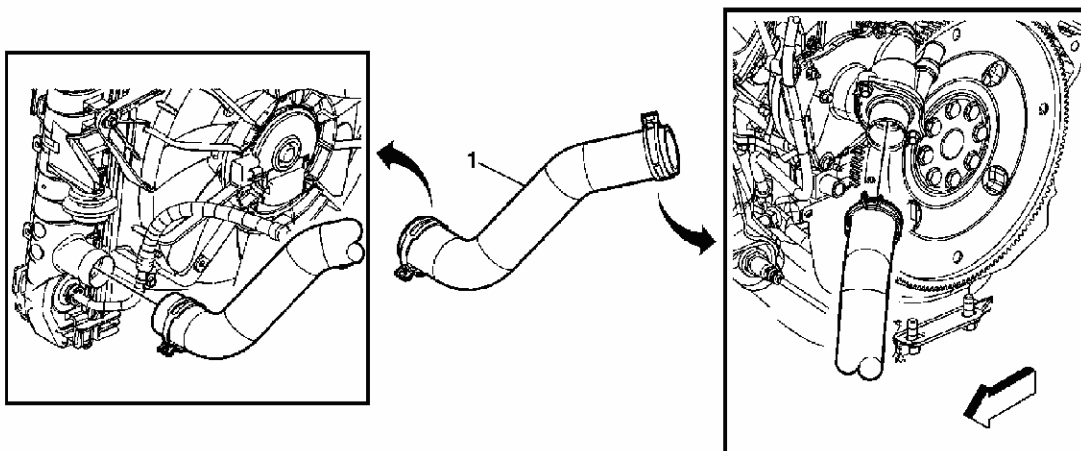


**Fig. 26: View Of Radiator Inlet Hose (L26)**  
Courtesy of GENERAL MOTORS CORP.

#### Radiator Inlet Hose Replacement (L26)

Callout	Component Name
<b>Fastener Tightening Specifications:</b> Refer to <u>Fastener Tightening Specifications</u> .	
<b>Preliminary Procedure:</b> Partially drain the cooling system. Refer to <u>Cooling System Draining and Filling (Static Fill)</u> or <u>Cooling System Draining and Filling (Vac-N-Fill)</u> .	
1	Radiator Inlet Hose <b>Tip:</b> Using <b>J 38185</b> Hose Clamp Pliers position the radiator inlet hose clamps aside and remove the hose from the radiator and engine.

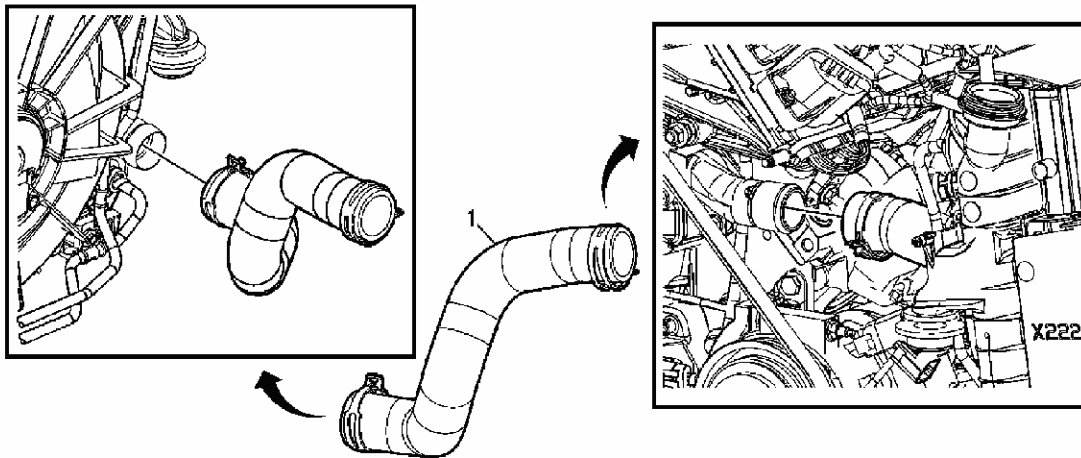
#### RADIATOR OUTLET HOSE REPLACEMENT (LD8)



**Fig. 27: View Of Radiator Outlet Hose (LD8)**  
Courtesy of GENERAL MOTORS CORP.

**Radiator Outlet Hose Replacement (LD8)**

Callout	Component Name
<b>Fastener Tightening Specifications:</b> Refer to <u>Fastener Tightening Specifications</u> .	
<b>Preliminary Procedure</b>	
<p><b>IMPORTANT:</b> Drain only the fluid from the radiator surge tank.</p> <ol style="list-style-type: none"> <li>1. Drain the cooling system. Refer to <u>Cooling System Draining and Filling (Static Fill)</u> or <u>Cooling System Draining and Filling (Vac-N-Fill)</u>.</li> <li>2. Remove the air cleaner assembly. Refer to <u>Air Cleaner Assembly Replacement</u>.</li> </ol>	
1	Radiator Outlet Hose <b>Tip:</b> Using <b>J 38185</b> Hose Clamp Pliers position the radiator outlet hose clamps aside and remove the hose from the radiator and engine.

**RADIATOR OUTLET HOSE REPLACEMENT (L26)****Fig. 28: View Of Radiator Outlet Hose (L26)**Courtesy of **GENERAL MOTORS CORP.****Radiator Outlet Hose Replacement (L26)**

Callout	Component Name
<b>Fastener Tightening Specifications:</b> Refer to <u>Fastener Tightening Specifications</u> .	
<b>Preliminary Procedure</b>	
<ol style="list-style-type: none"> <li>1. Partially drain the cooling system. Refer to <u>Cooling System Draining and Filling (Static Fill)</u> or <u>Cooling System Draining and Filling (Vac-N-Fill)</u>.</li> </ol>	

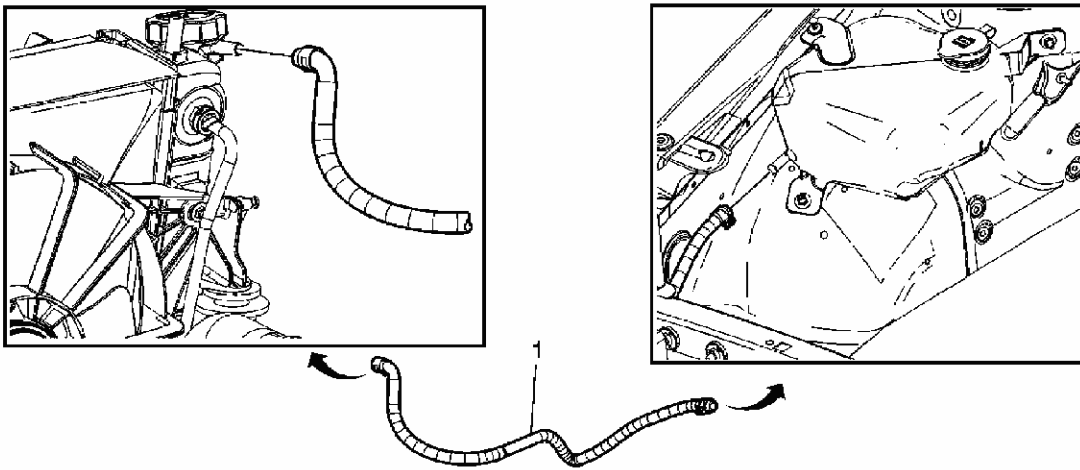
2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement**.

1

Radiator Outlet Hose

**Tip:** Using **J 38185** Hose Clamp Pliers position the radiator outlet hose clamps aside and remove the hose from the radiator and engine.

## RADIATOR VENT INLET HOSE REPLACEMENT



**Fig. 29: View Of Radiator Vent Inlet Hose**  
Courtesy of **GENERAL MOTORS CORP.**

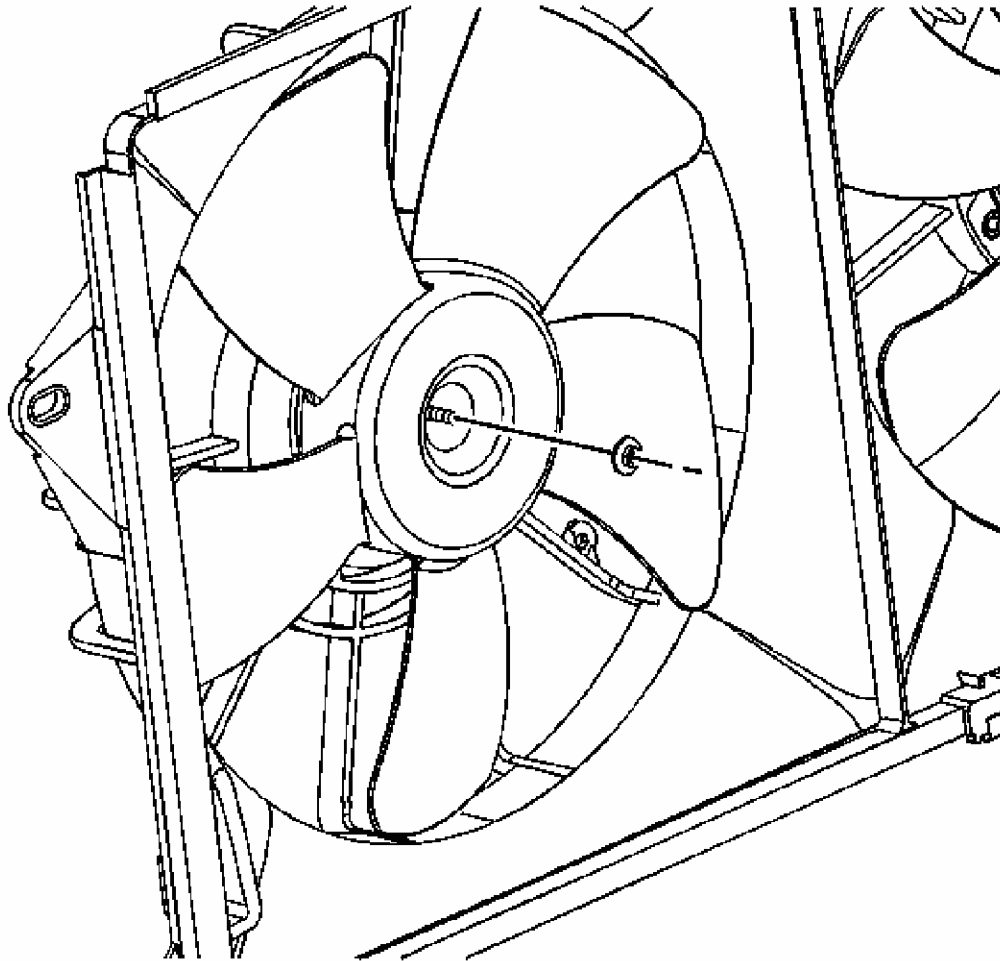
## Radiator Vent Inlet Hose Replacement

Callout	Component Name
<b>Fastener Tightening Specifications:</b> Refer to <b><u>Fastener Tightening Specifications</u></b> . <b>Preliminary Procedure:</b>  <b>IMPORTANT:</b> Drain only the fluid from the coolant recovery reservoir.  Drain the cooling system. Refer to <b><u>Cooling System Draining and Filling (Static Fill)</u></b> or <b><u>Cooling System Draining and Filling (Vac-N-Fill)</u></b> .	
1	Radiator Inlet Vent Hose <b>Tip:</b> <ol style="list-style-type: none"> <li>Note the routing of the radiator inlet vent hose to ensure proper installation.</li> <li>Using <b>J 38185</b> Hose Clamp Pliers position the radiator inlet vent hose clamps aside and remove the hose from the reservoir and radiator.</li> </ol>

## **ENGINE COOLING FAN REPLACEMENT**

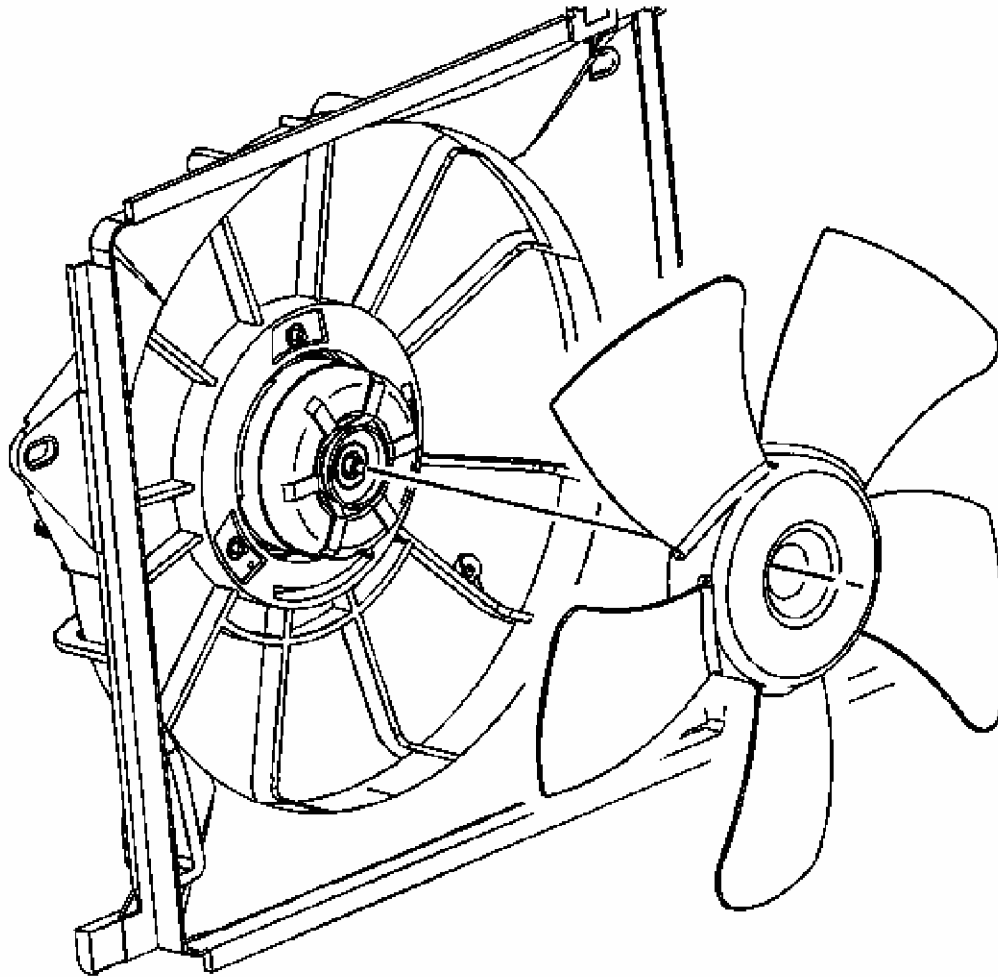
### **Removal Procedure**

1. Remove the cooling fan shroud assembly. Refer to **Fan Shroud Replacement (L26)** or **Fan Shroud Replacement (LD8)**.



**Fig. 30: Identifying Cooling Fan Blade Retaining Nut**  
**Courtesy of GENERAL MOTORS CORP.**

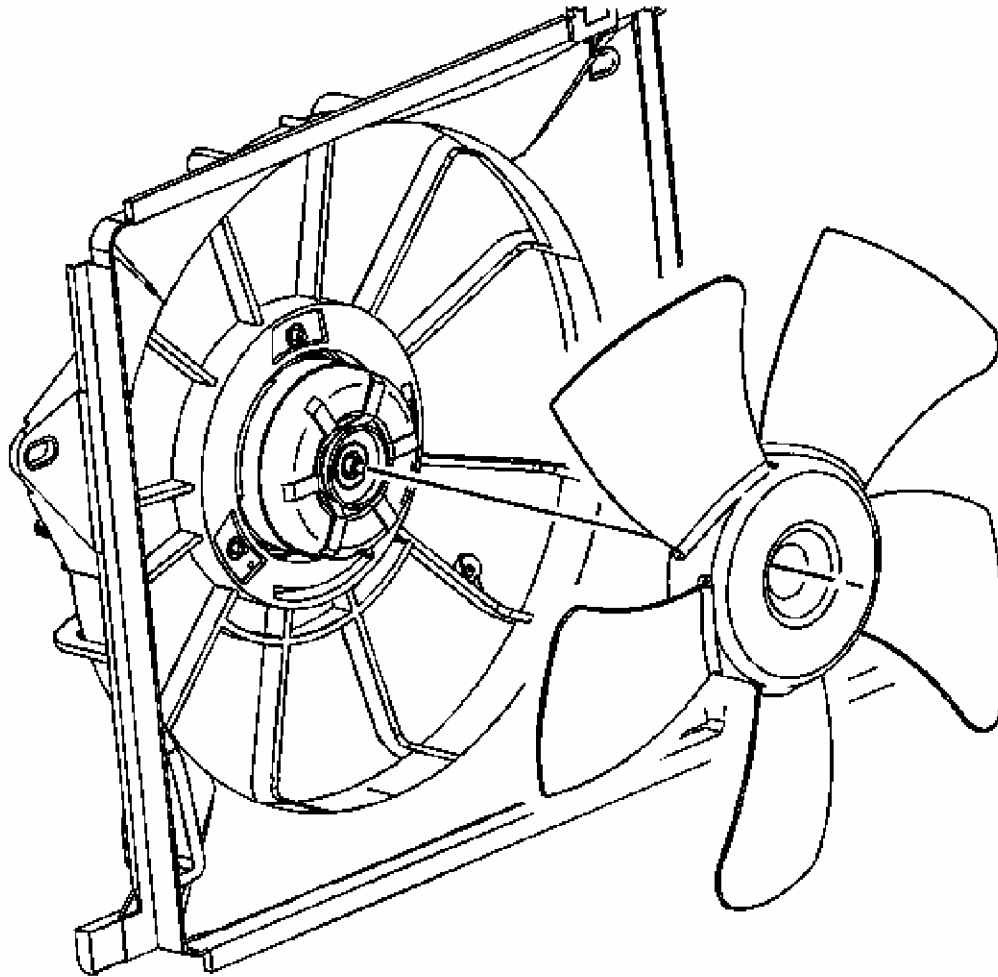
2. Remove the cooling fan blade retaining nut.



**Fig. 31: Removing/Installing Engine Cooling Fan**  
**Courtesy of GENERAL MOTORS CORP.**

3. Remove the cooling fan blade.

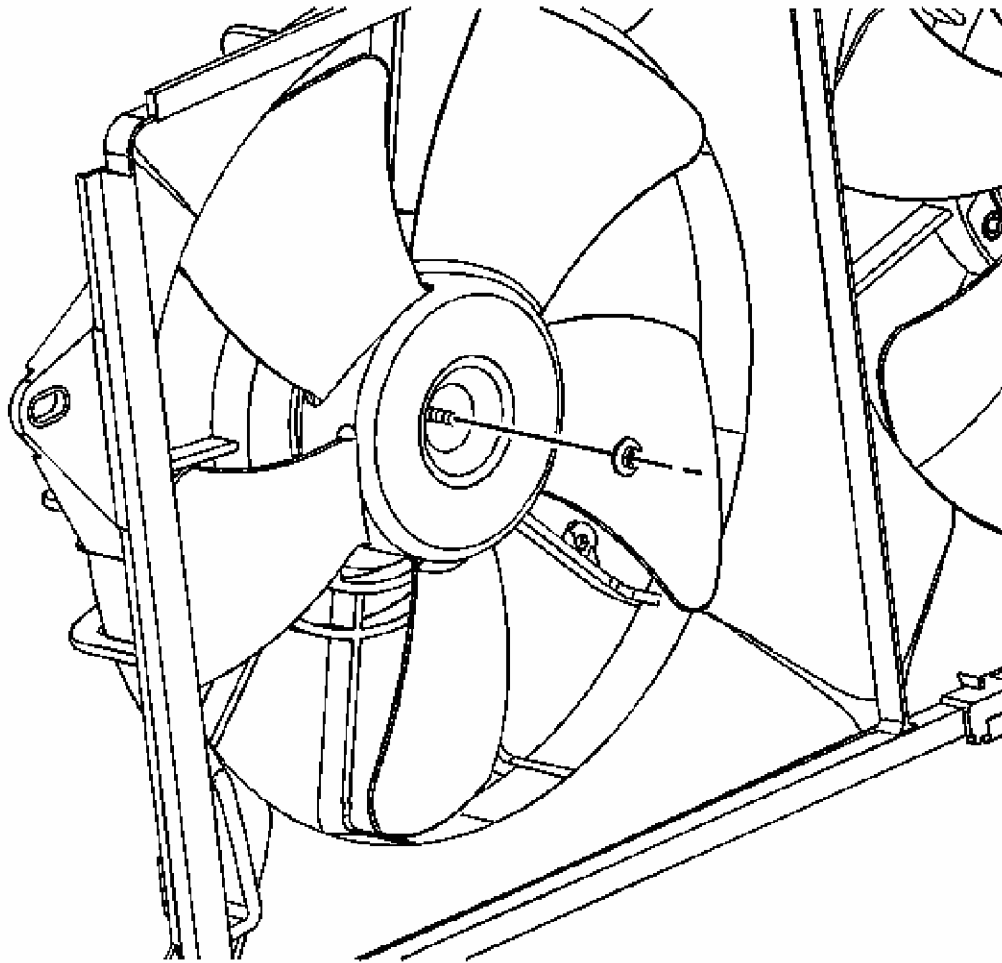
**Installation Procedure**



**Fig. 32: Removing/Installing Engine Cooling Fan**  
**Courtesy of GENERAL MOTORS CORP.**

1. Install the cooling fan blade.





**Fig. 33: Identifying Cooling Fan Blade Retaining Nut**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to Fastener Notice .

2. Install the cooling fan retaining nut.

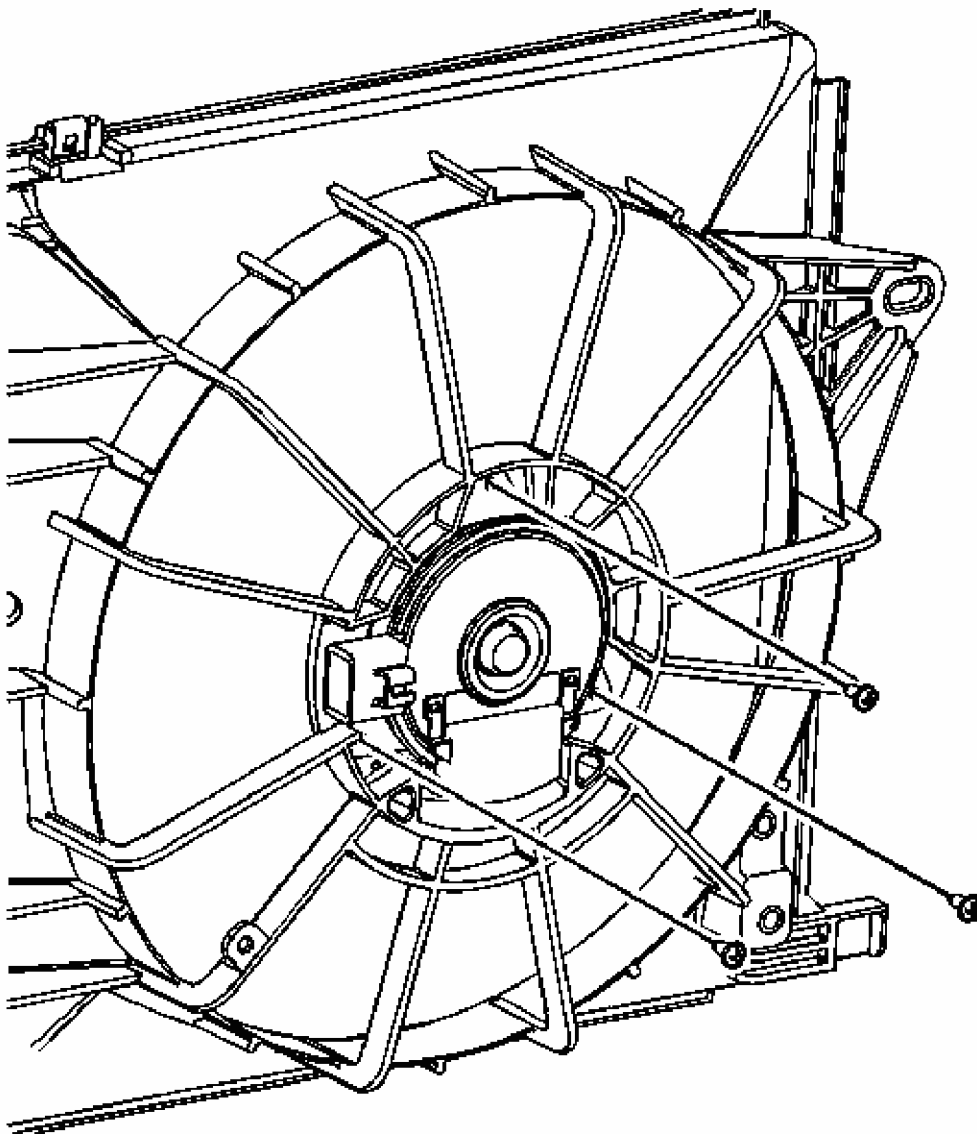
**Tighten:** Tighten the nut to 6 N.m (53 lb in).

3. Install the cooling fan shroud assembly. Refer to Fan Shroud Replacement (L26) or Fan Shroud Replacement (LD8).

## ENGINE COOLANT FAN MOTOR REPLACEMENT

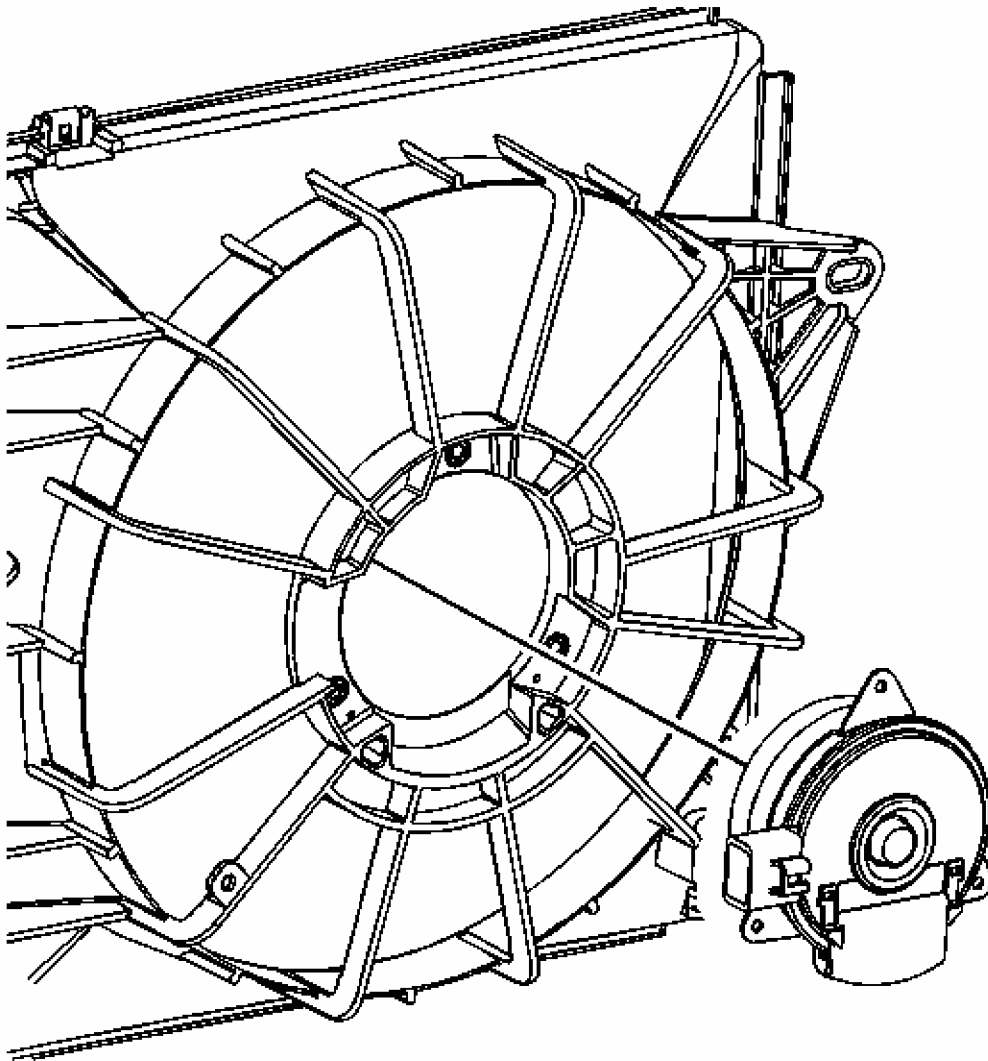
### Removal Procedure

1. Remove the cooling fan assembly. Refer to **Fan Shroud Replacement (L26)** or **Fan Shroud Replacement (LD8)**.
2. Remove the cooling fan. Refer to **Engine Cooling Fan Replacement**.



**Fig. 34: Identifying Cooling Fan Motor Retaining Bolts**  
Courtesy of GENERAL MOTORS CORP.

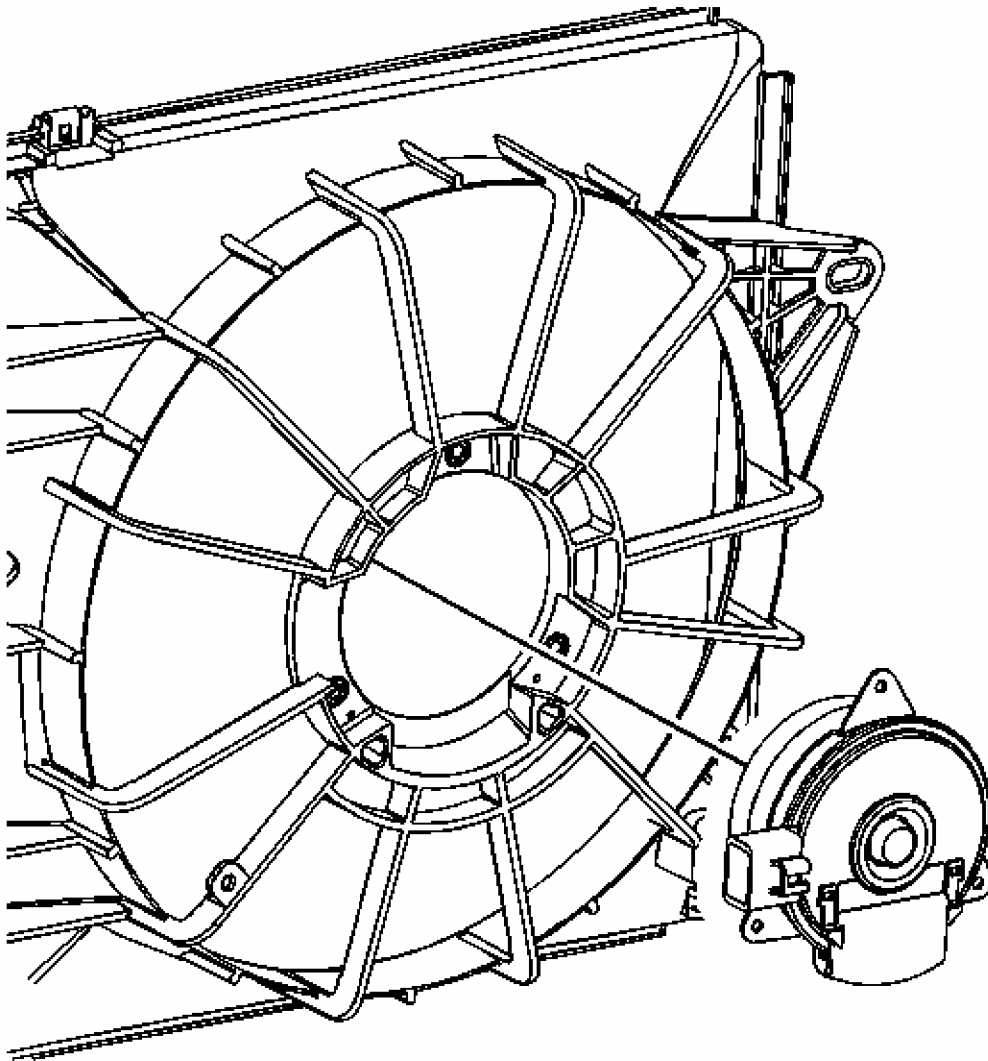
3. Remove the cooling fan motor retaining bolts.



**Fig. 35: Removing/Installing Cooling Fan Motor**  
**Courtesy of GENERAL MOTORS CORP.**

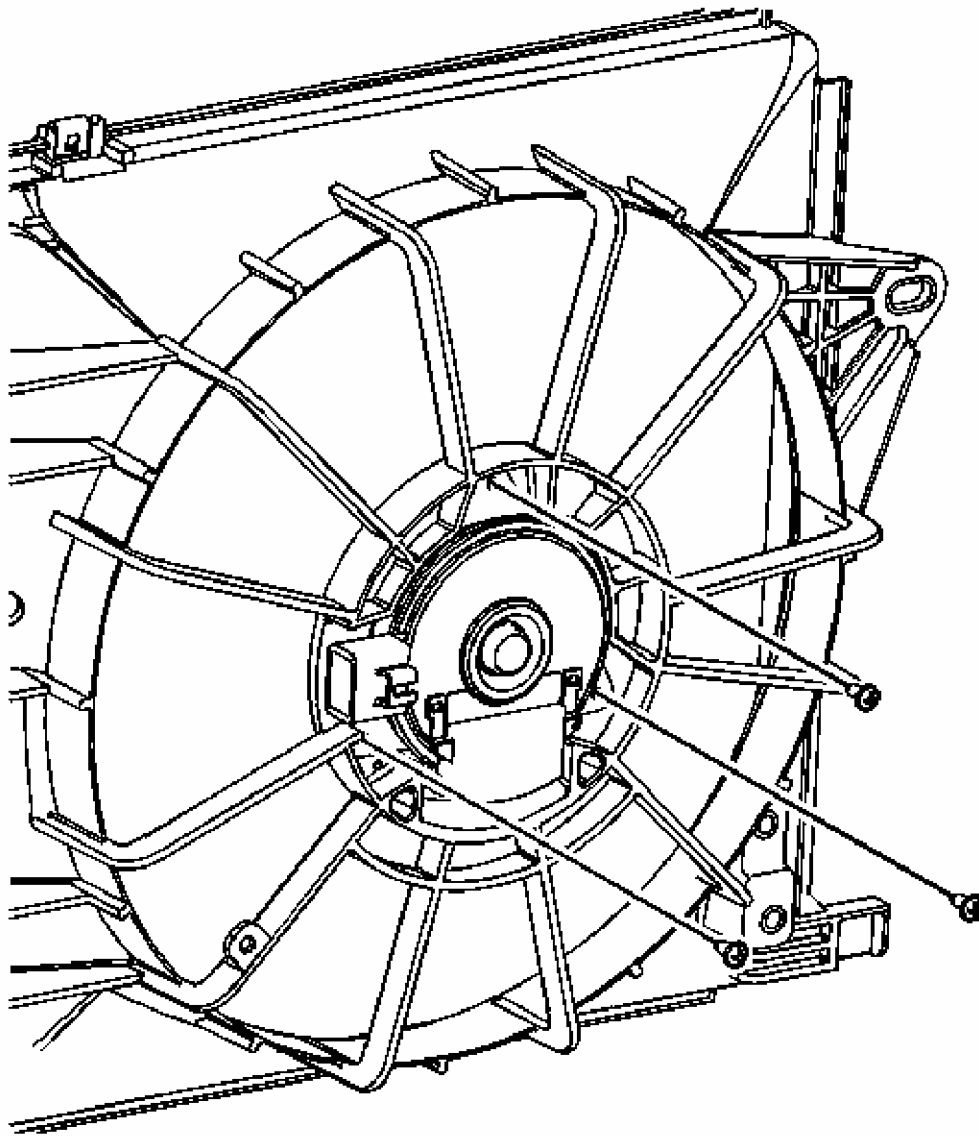
4. Remove the cooling fan motor from the fan shroud.

**Installation Procedure**



**Fig. 36: Removing/Installing Cooling Fan Motor**  
**Courtesy of GENERAL MOTORS CORP.**

1. Install the cooling fan motor to the fan shroud.



**Fig. 37: Identifying Cooling Fan Motor Retaining Bolts**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to Fastener Notice .

2. Install the cooling fan motor retaining bolts.

**Tighten:** Tighten the bolts to 6 N.m (53 lb in).

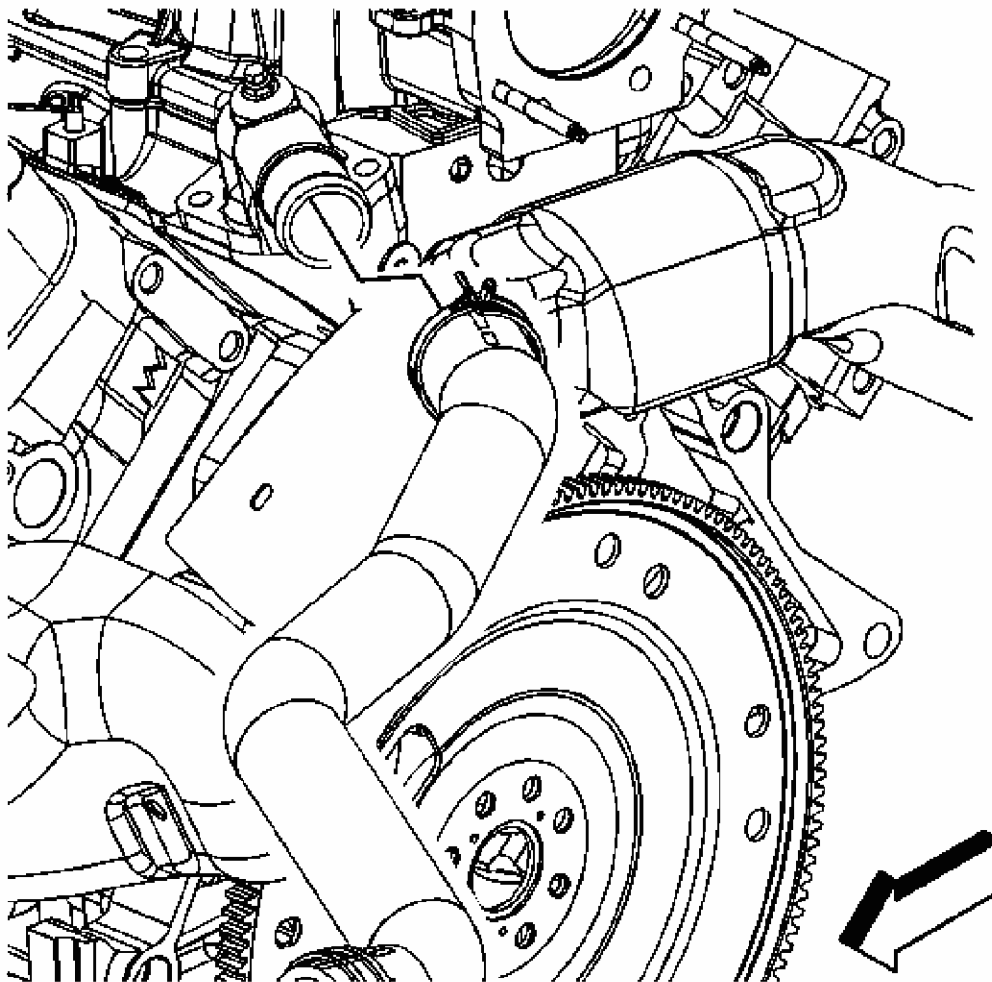
3. Install the cooling fan. Refer to **Engine Cooling Fan Replacement**.
4. Install the cooling fan assembly. Refer to **Fan Shroud Replacement (L26)** or **Fan Shroud Replacement (LD8)**.

#### **ENGINE COOLANT THERMOSTAT REPLACEMENT (L26)**

##### **Tools Required**

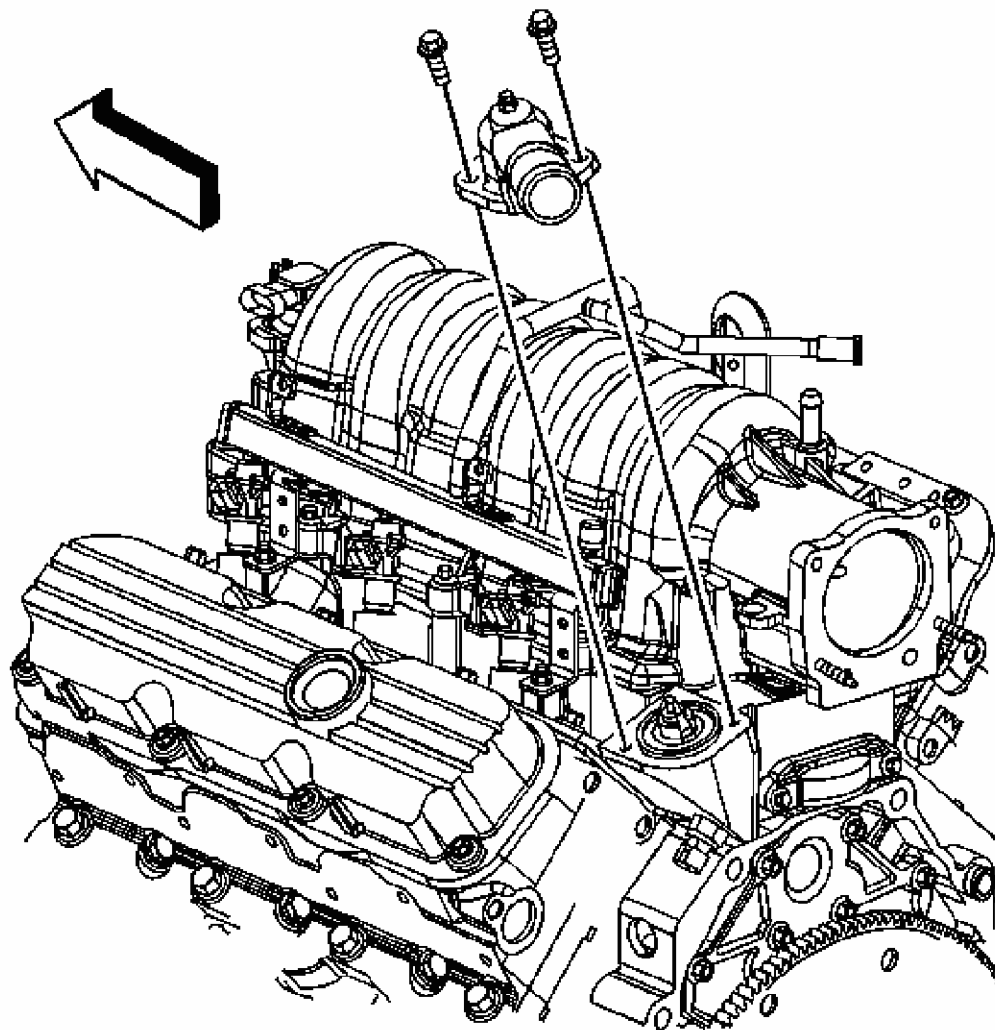
**J 38185** Hose Clamp Pliers

##### **Removal Procedure**



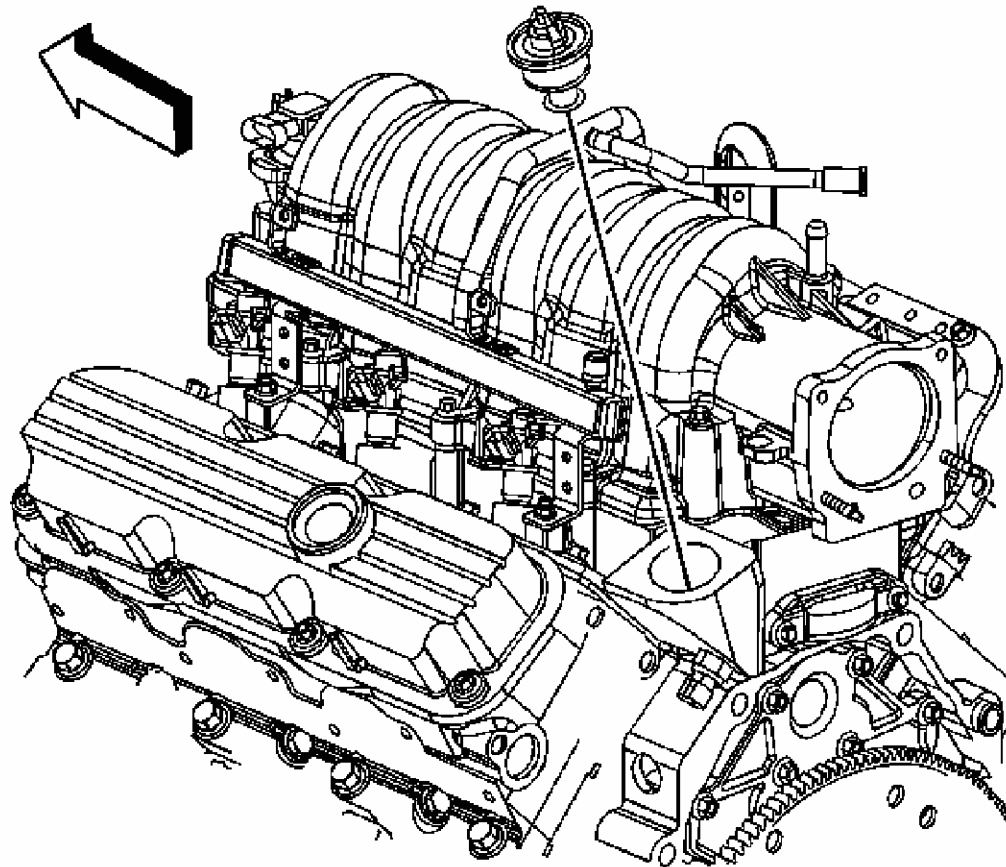
**Fig. 38: Locating Inlet Hose Clamps**  
**Courtesy of GENERAL MOTORS CORP.**

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
2. Partially drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac-N-Fill)**.
3. Using **J 38185** reposition the hose clamp at the thermostat housing.
4. Remove the radiator inlet hose from the thermostat housing.



**Fig. 39: Removing/Installing Thermostat Housing**  
Courtesy of GENERAL MOTORS CORP.

5. Remove the thermostat housing bolts and housing.

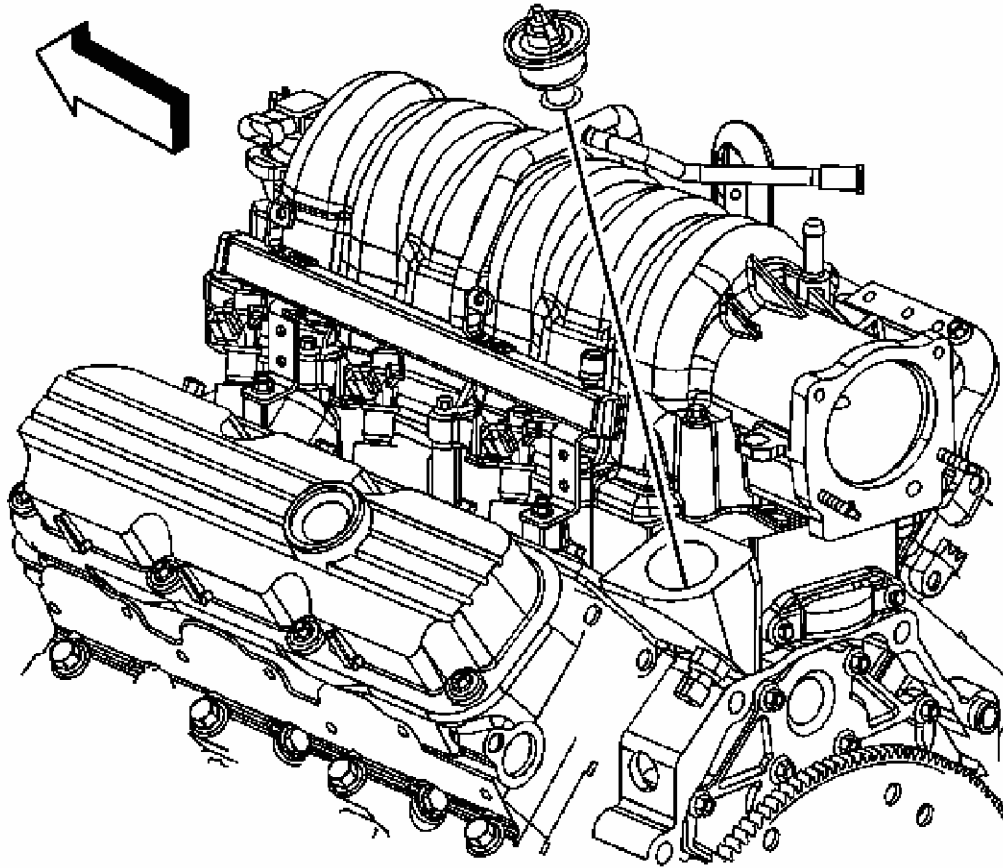


**Fig. 40: Removing/Installing Thermostat**  
**Courtesy of GENERAL MOTORS CORP.**

6. Remove the thermostat.
7. Inspect and clean the thermostat housing mating surfaces.

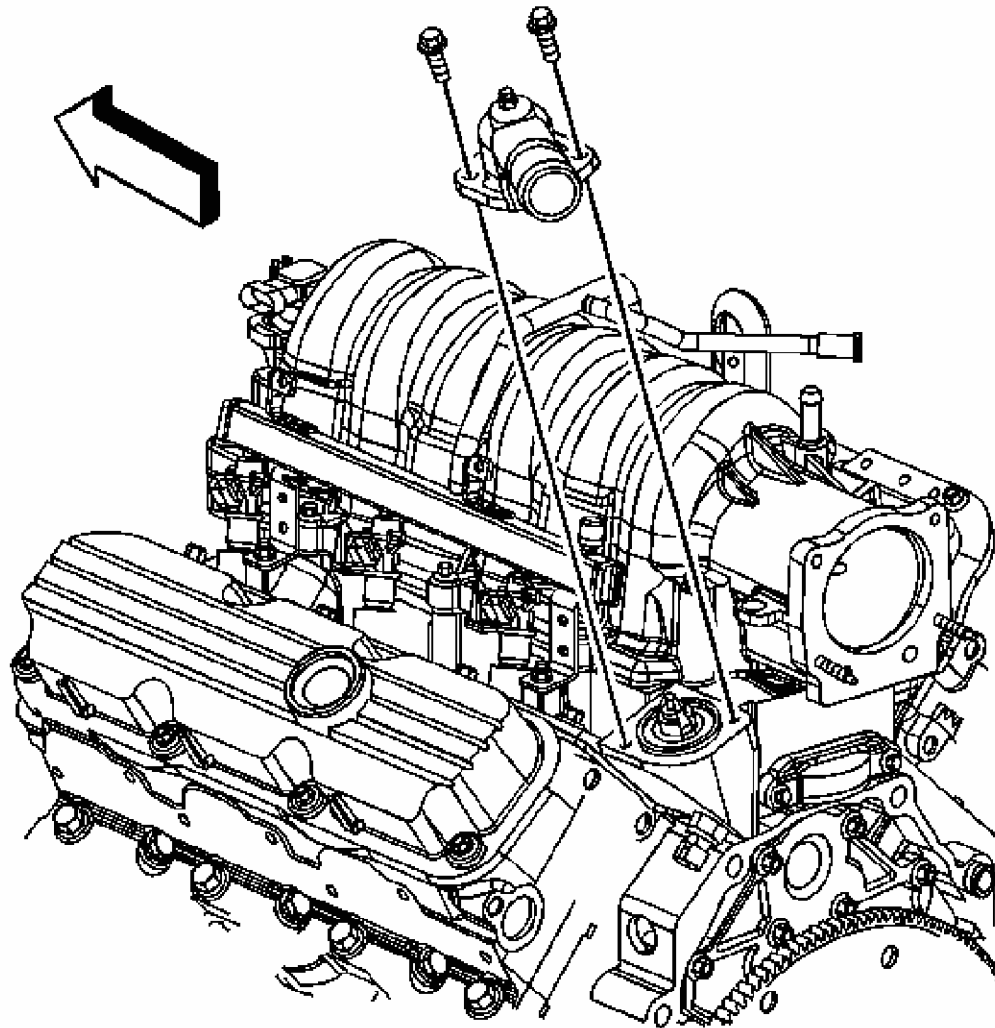
**Installation Procedure**





**Fig. 41: Removing/Installing Thermostat**  
**Courtesy of GENERAL MOTORS CORP.**

1. Install the thermostat.

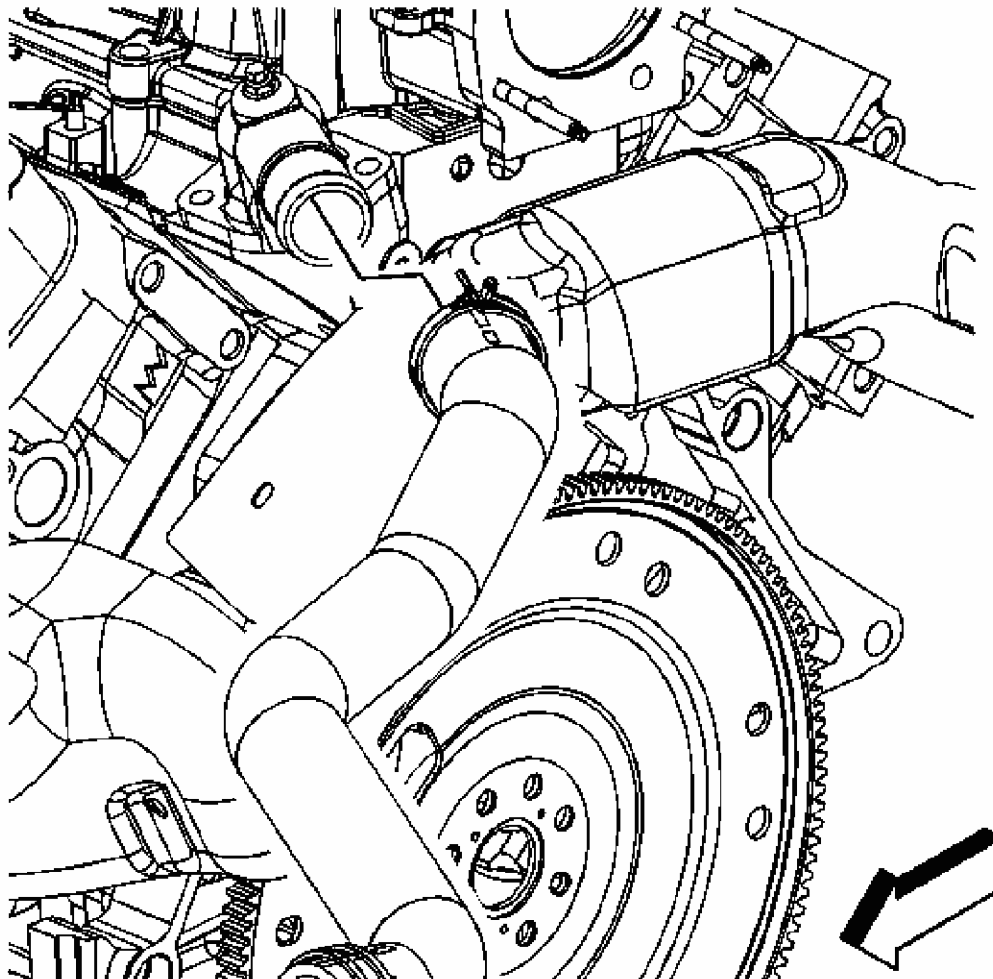


**Fig. 42: Removing/Installing Thermostat Housing**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to Fastener Notice .

2. Install the thermostat housing and bolts.

**Tighten:** Tighten the bolts to 25 N.m (18 lb ft).



**Fig. 43: Locating Inlet Hose Clamps**  
**Courtesy of GENERAL MOTORS CORP.**

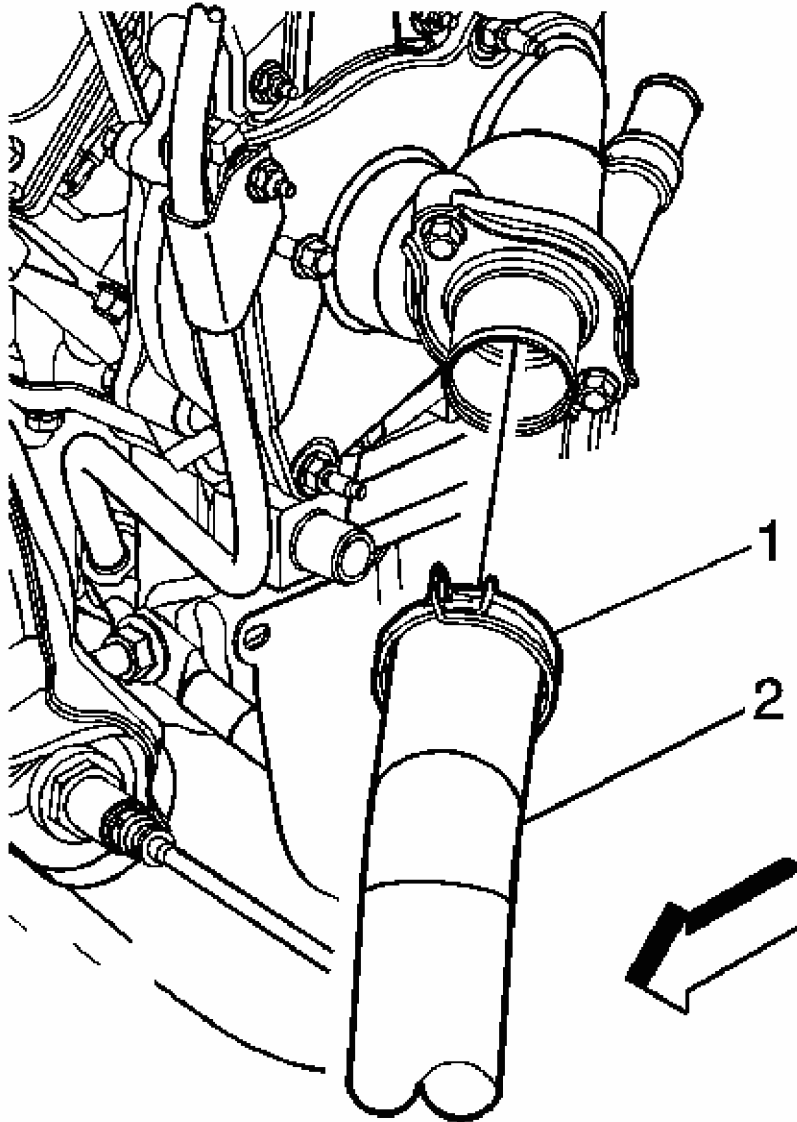
3. Install the radiator inlet hose to the thermostat housing.
4. Using **J 38185** position the hose clamp at the thermostat housing.
5. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac-N-Fill)**.
6. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

#### **ENGINE COOLANT THERMOSTAT REPLACEMENT (LD8)**

##### **Tools Required**

## **J 38185 Hose Clamp Pliers**

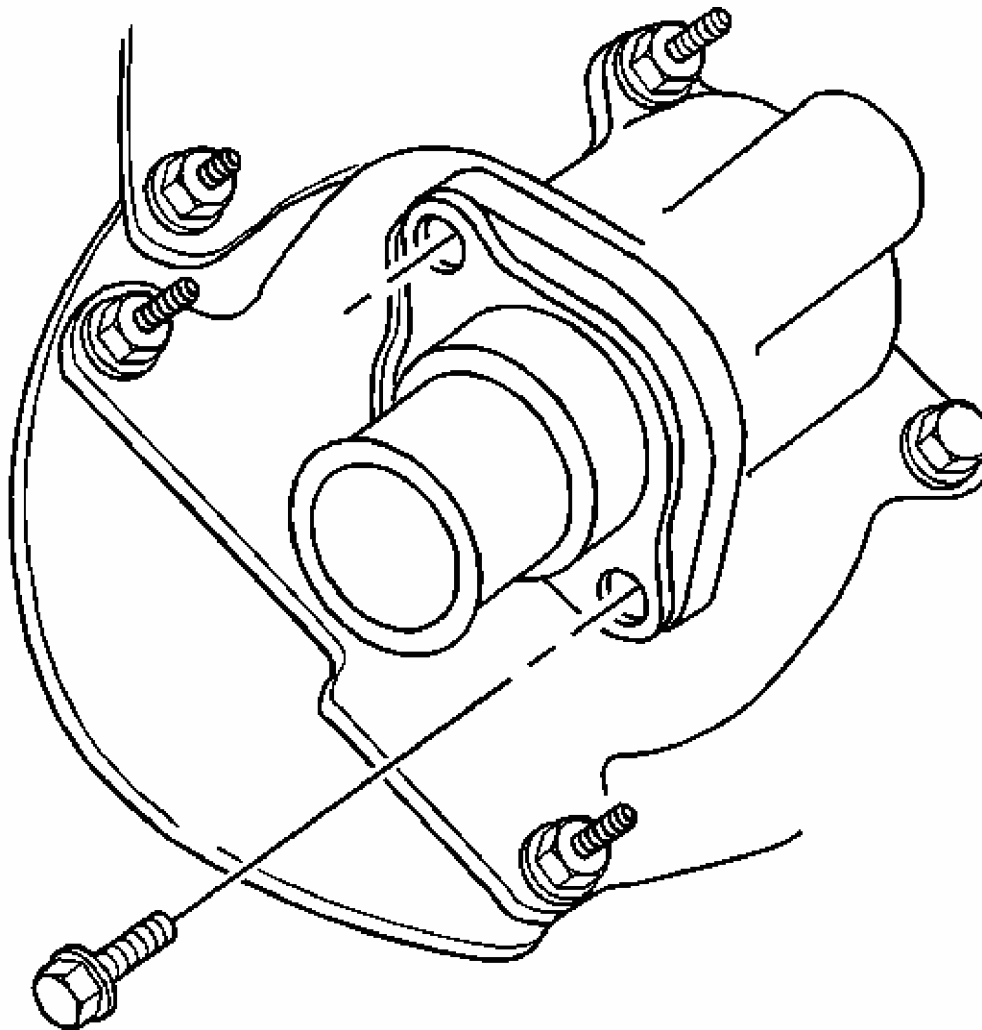
### **Removal Procedure**



**Fig. 44: View Of Radiator Outlet Hose At Thermostat Housing**  
**Courtesy of GENERAL MOTORS CORP.**

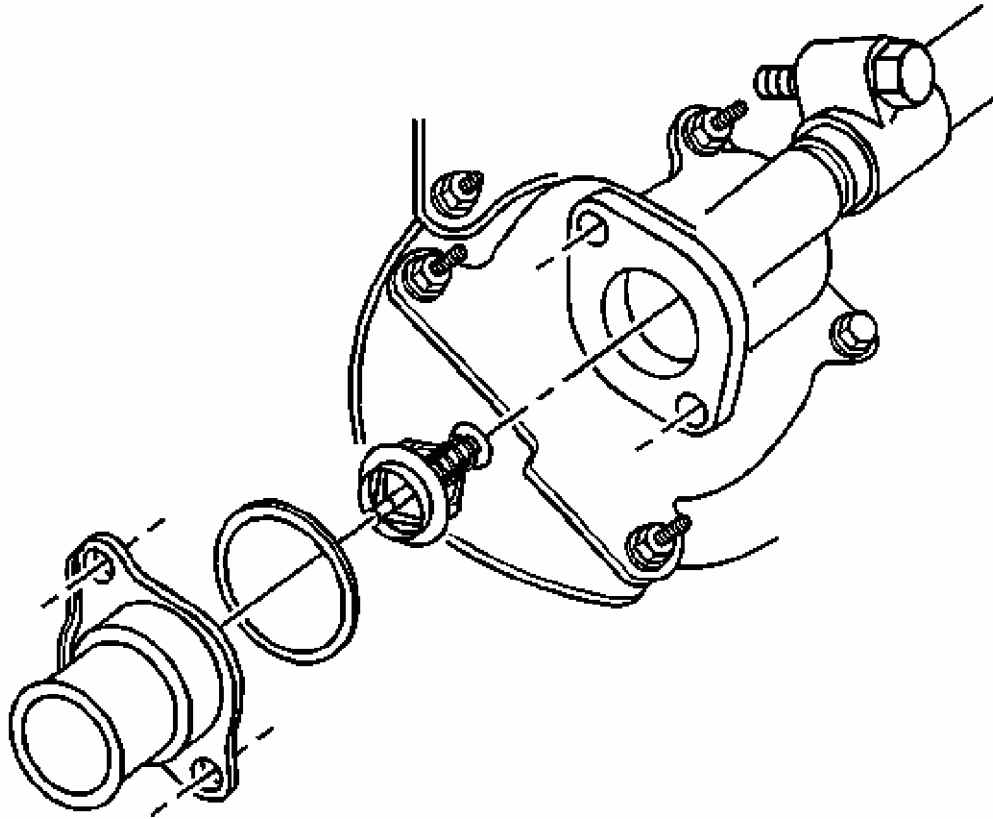
1. Remove the air cleaner. Refer to **Air Cleaner Assembly Replacement** .
2. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac-N-Fill)**.

3. Using the **J 38185** , reposition the radiator outlet hose clamp at the thermostat housing.
4. Remove the radiator outlet hose from the thermostat housing.



**Fig. 45: Identifying Thermostat Housing/Water Pump Inlet Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

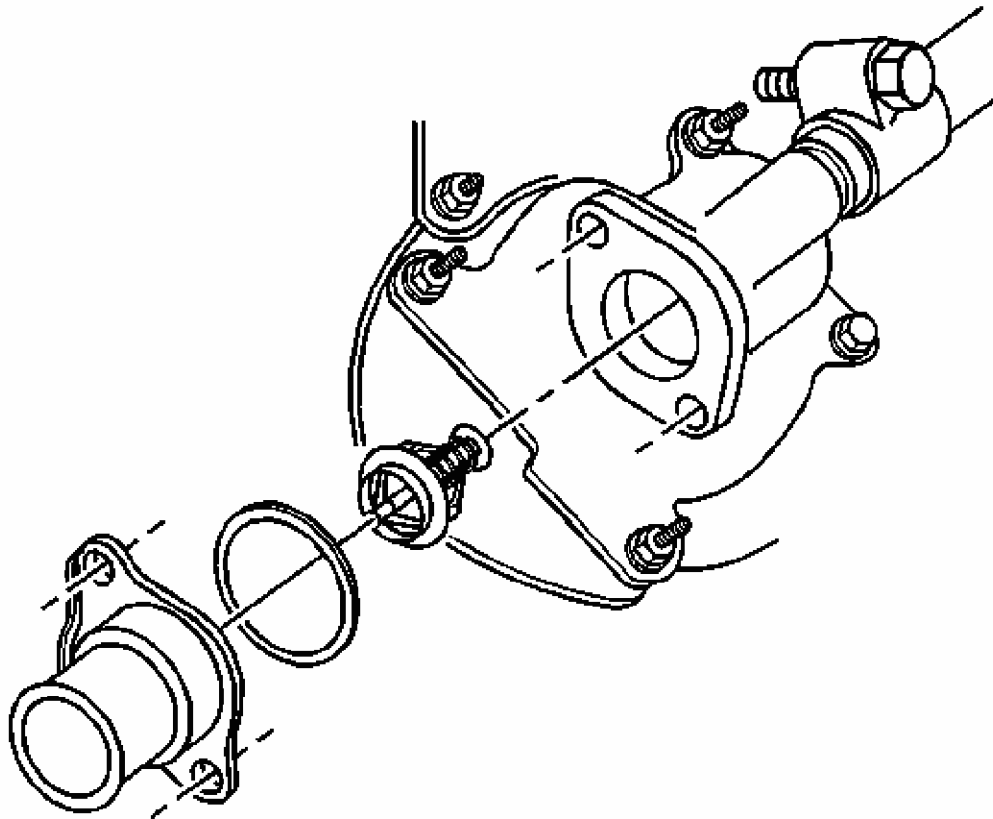
5. Remove the thermostat housing bolts.



**Fig. 46: View of Thermostat & Gasket**  
**Courtesy of GENERAL MOTORS CORP.**

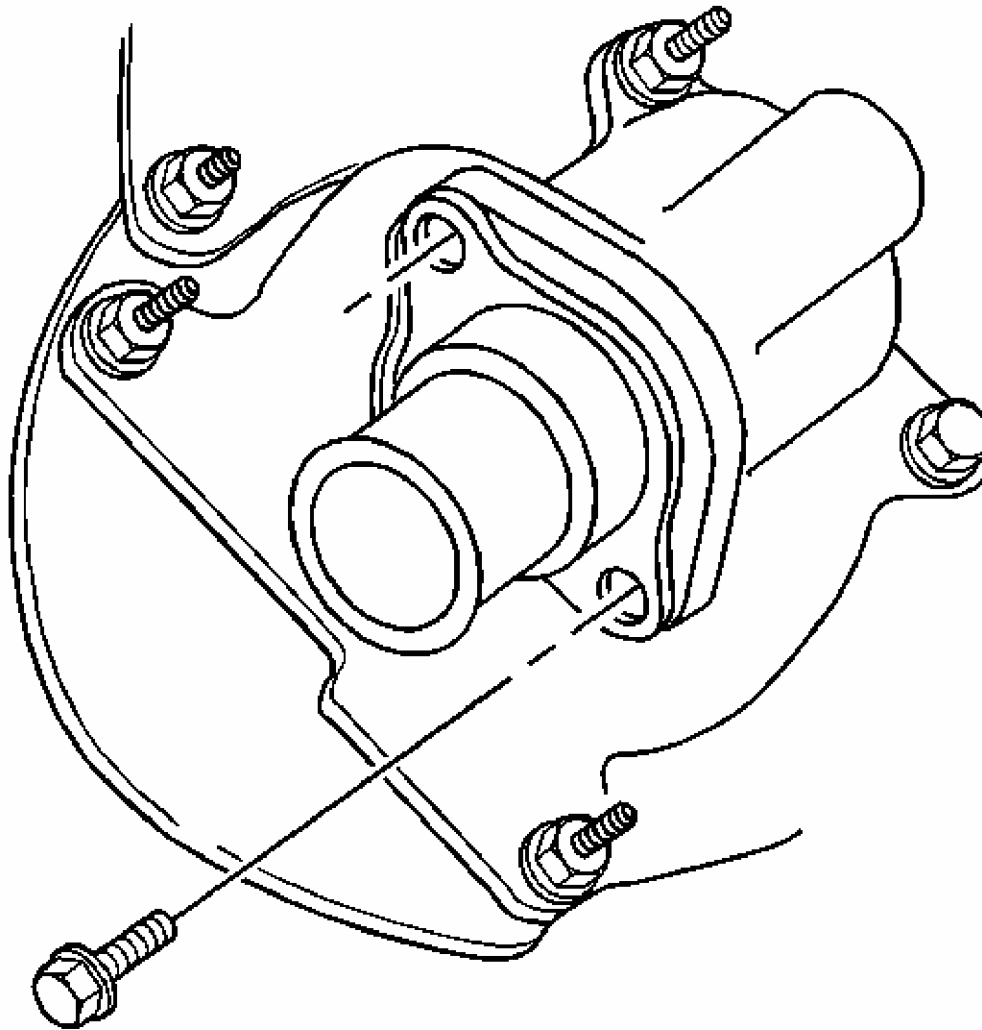
6. Remove the thermostat housing, thermostat and gasket from the water pump housing.
7. Discard the old thermostat housing gasket.

**Installation Procedure**



**Fig. 47: View of Thermostat & Gasket**  
**Courtesy of GENERAL MOTORS CORP.**

1. Install a NEW thermostat housing gasket into the water pump housing.
2. Install the thermostat into the water pump housing.
3. Install the thermostat housing.



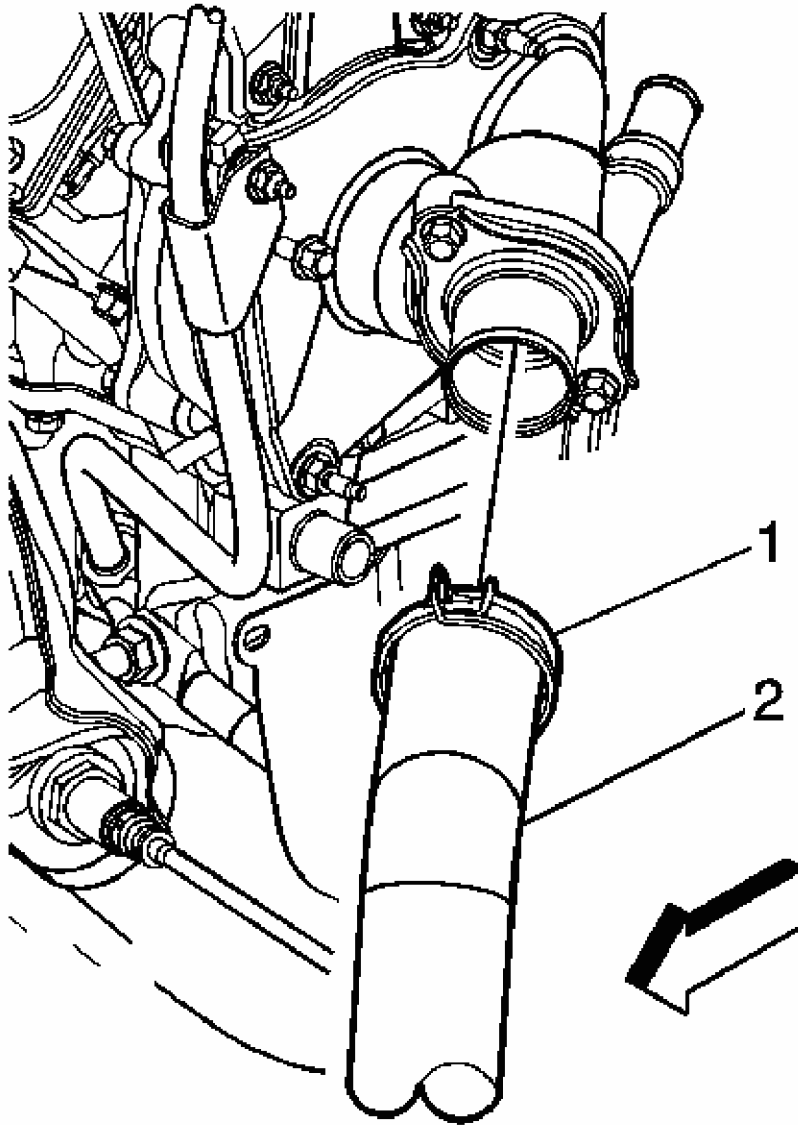
**Fig. 48: Identifying Thermostat Housing/Water Pump Inlet Bolts**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to Fastener Notice .

4. Install the thermostat housing bolts.

**Tighten:** Tighten the bolts to 10 N.m (89 lb in).





**Fig. 49: View Of Radiator Outlet Hose At Thermostat Housing**  
**Courtesy of GENERAL MOTORS CORP.**

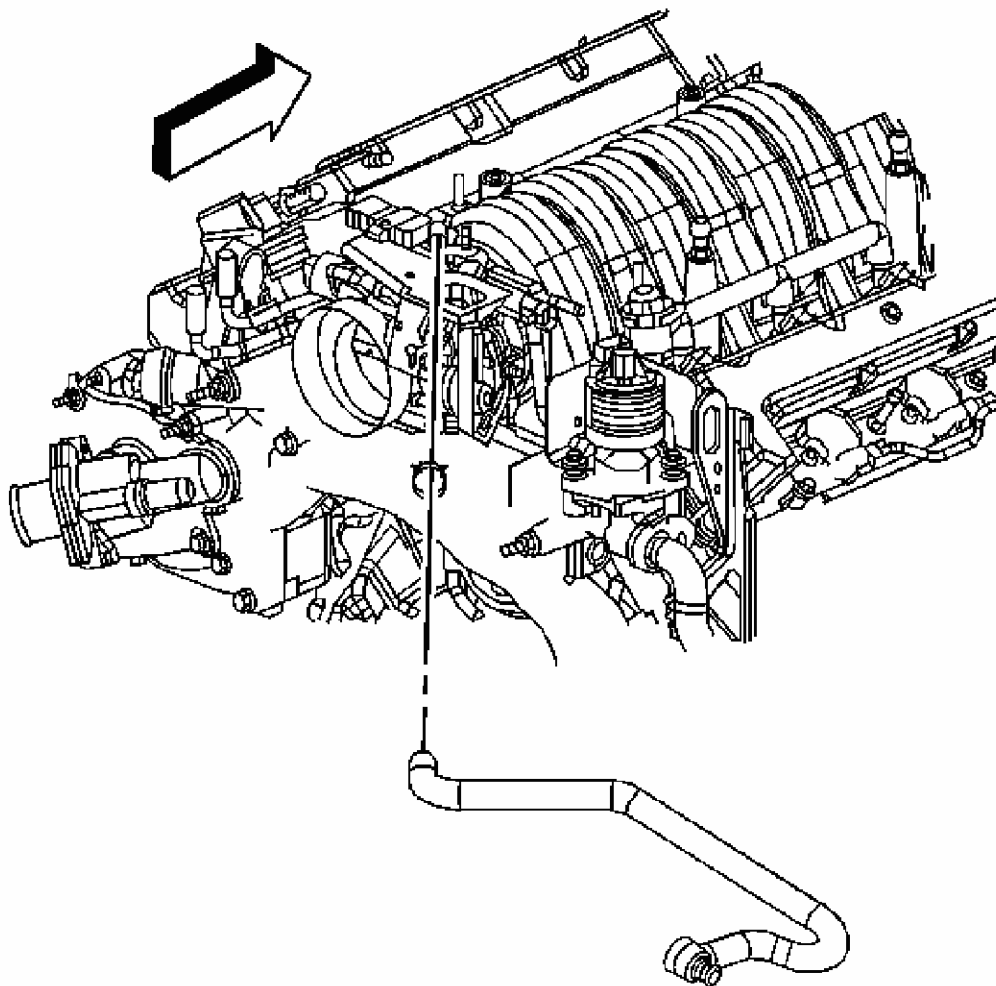
5. Install the radiator outlet hose to the thermostat housing.
6. Using the **J 38185** , position the radiator outlet hose clamp at the thermostat housing.
7. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac-N-Fill)**.
8. Install the air cleaner. Refer to **Air Cleaner Assembly Replacement** .

## ENGINE COOLANT CROSSOVER PIPE REPLACEMENT (LD8)

### Tools Required

**J 38185** Hose Clamp Pliers

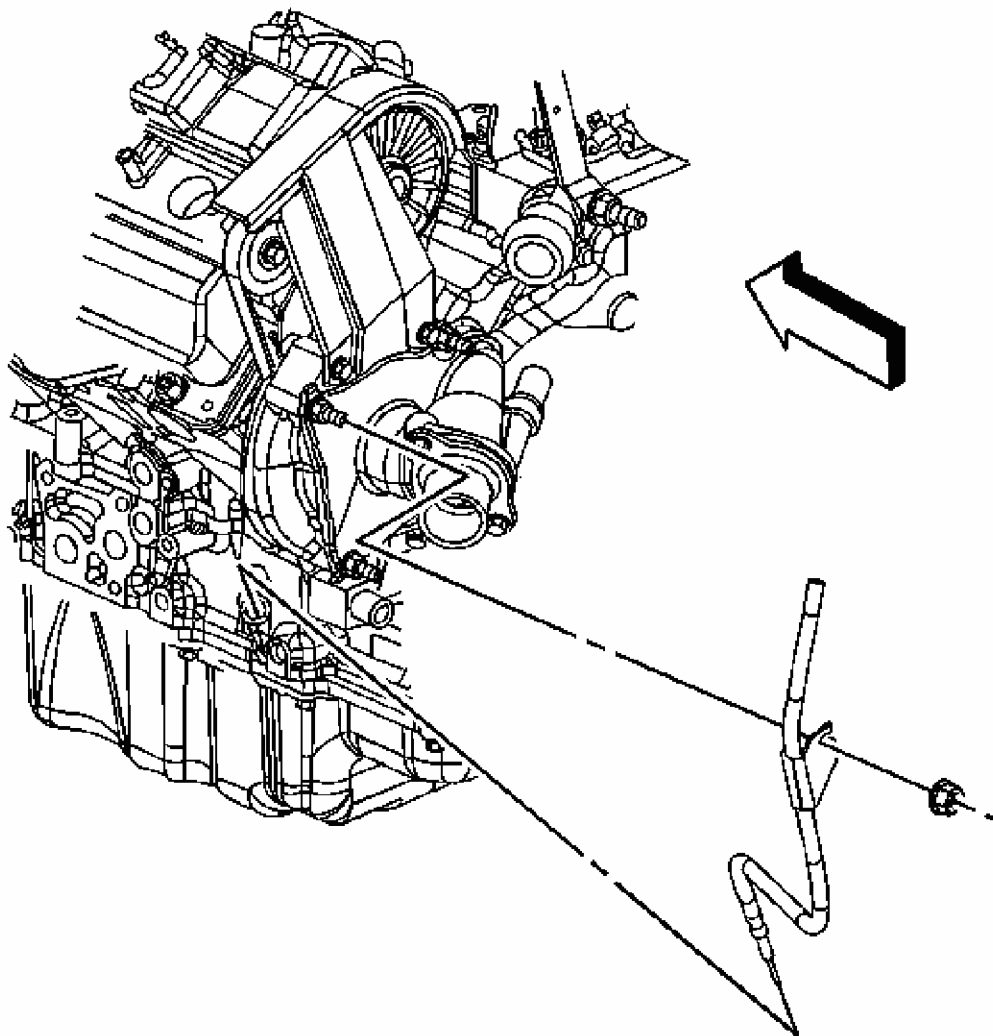
### Removal Procedure



**Fig. 50: View Of Coolant Crossover Pipe**  
**Courtesy of GENERAL MOTORS CORP.**

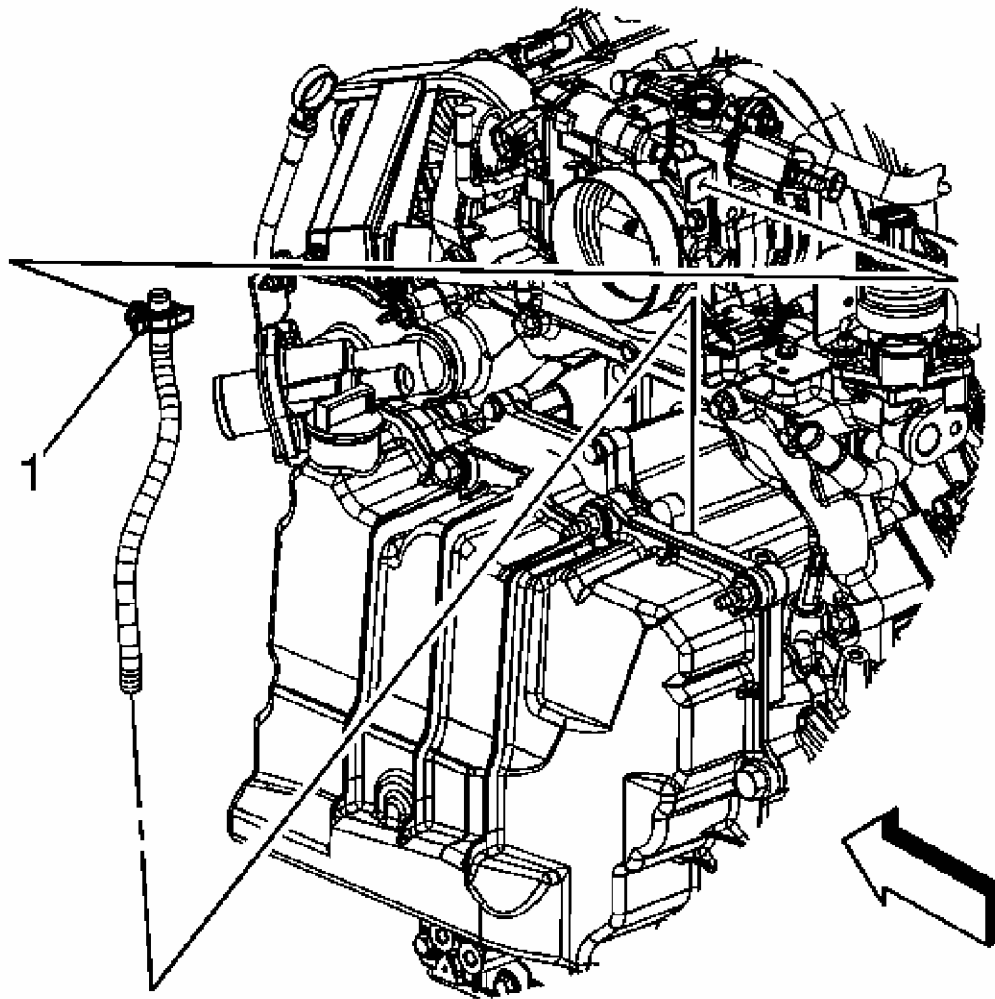
1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac-N-Fill)**.
2. Remove the air cleaner. Refer to **Air Cleaner Assembly Replacement**.

3. Remove the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement**.
4. Remove the water pump drive belt. Refer to **Water Pump Belt Replacement (LD8)**.
5. Reposition the brake booster vacuum hose clamp at the water pump housing.
6. Remove the brake booster vacuum hose from the water pump housing.



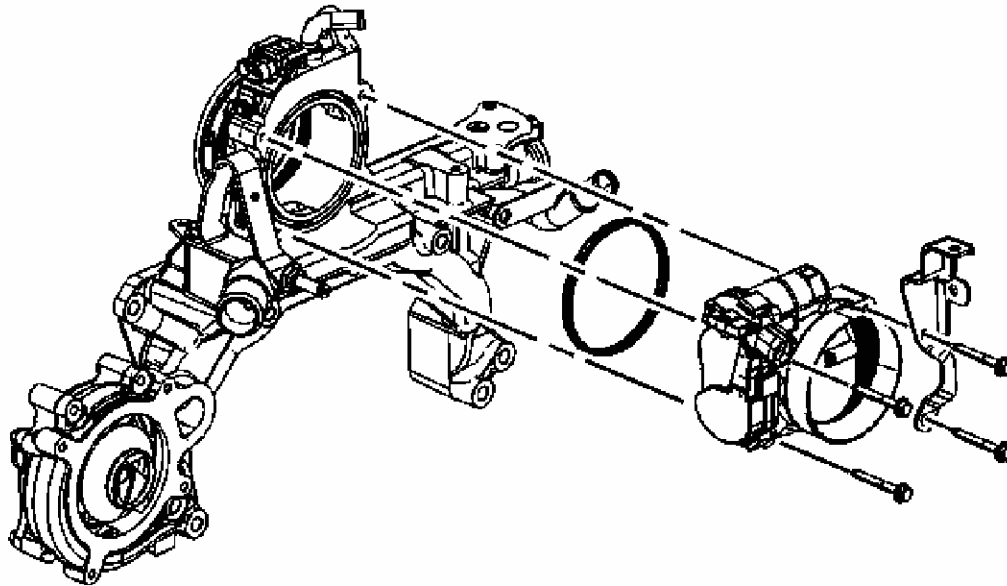
**Fig. 51: Identifying Oil Level Indicator Tube**  
**Courtesy of GENERAL MOTORS CORP.**

7. Remove the oil level indicator tube nut.
8. Reposition the oil level indicator tube.



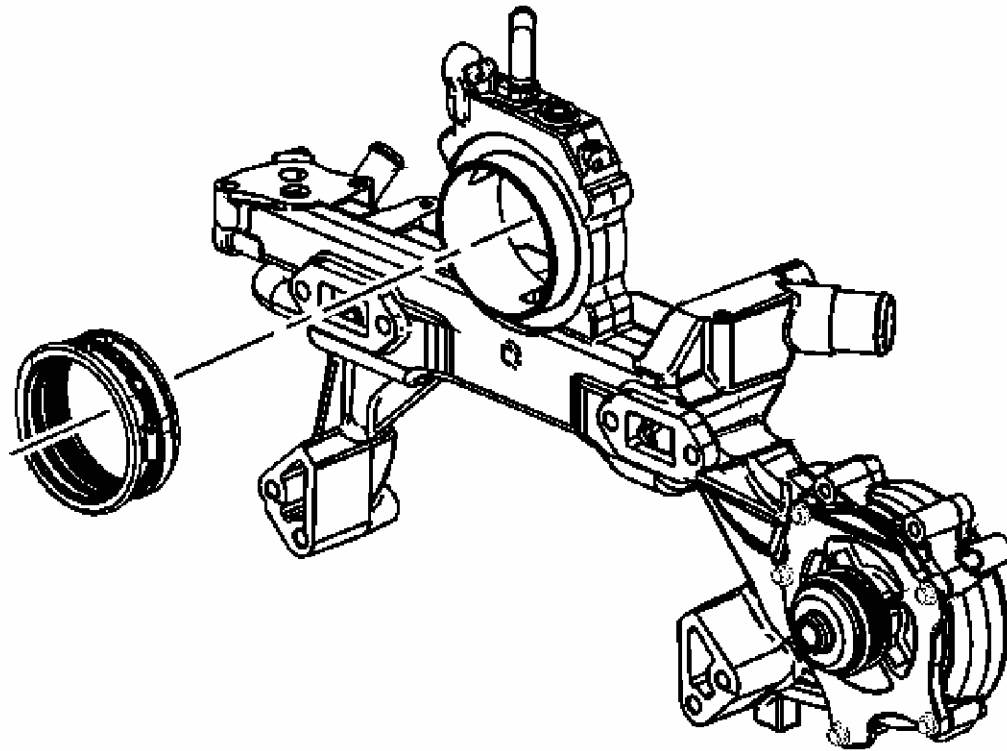
**Fig. 52: Identifying Transaxle Vent Hose Clip**  
**Courtesy of GENERAL MOTORS CORP.**

9. Remove the transaxle vent hose clip (1) from the bracket.



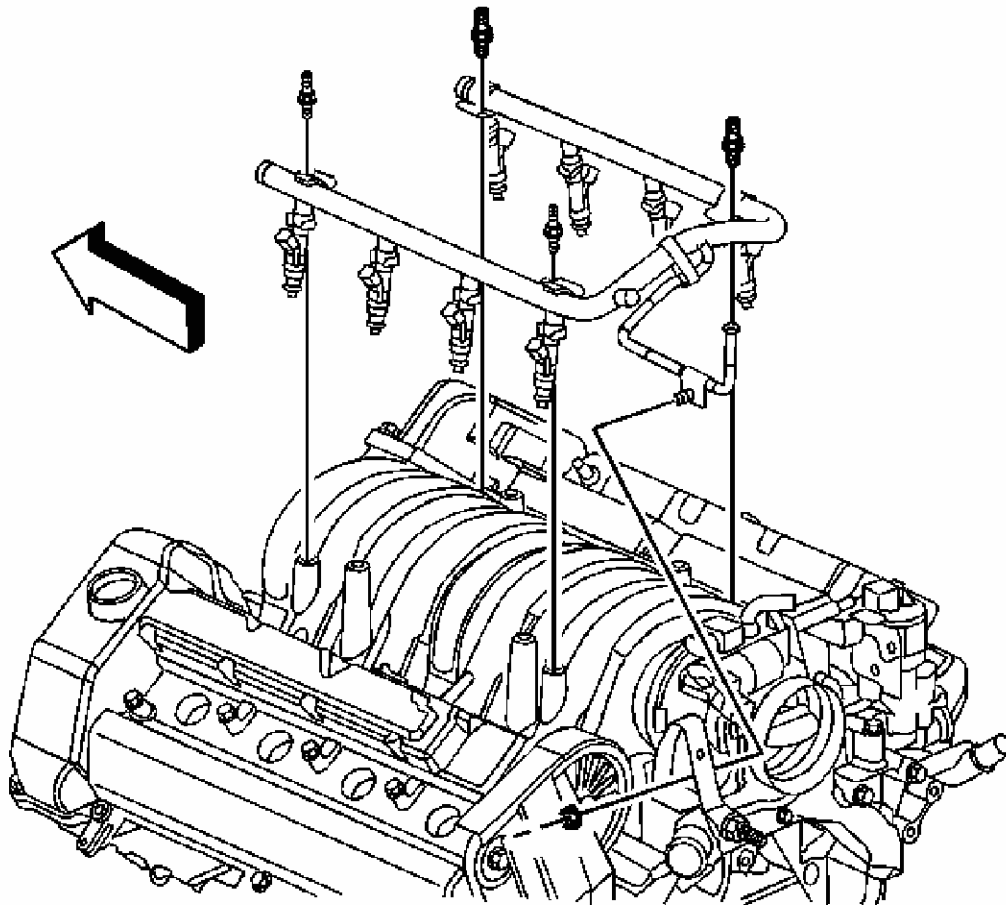
**Fig. 53: View Of Throttle Body Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

10. Remove the throttle body bolts.
11. Remove the bracket.
12. Remove the throttle body.
13. Remove and discard the throttle body seal.



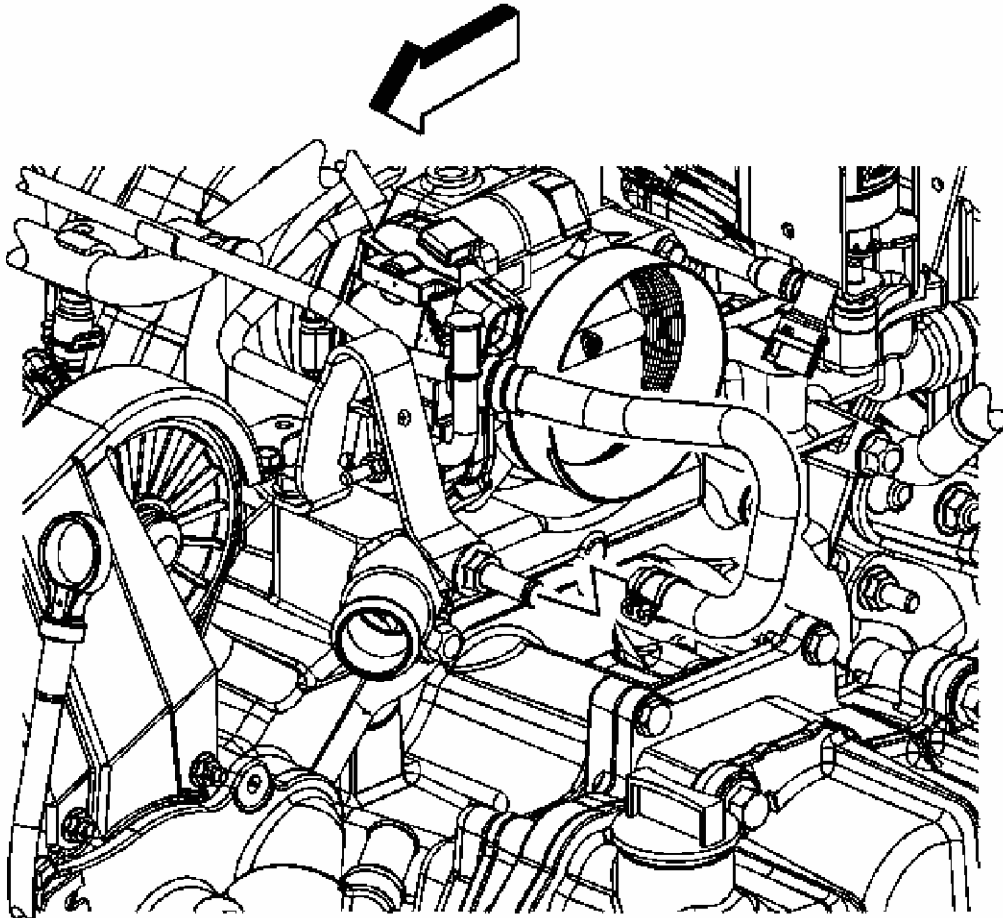
**Fig. 54: Identifying Throttle Body Plenum Duct**  
**Courtesy of GENERAL MOTORS CORP.**

14. Loosen the throttle body plenum duct clamp.
15. Remove and discard the throttle body plenum duct.



**Fig. 55: View Of Fuel Rail, Bracket & Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

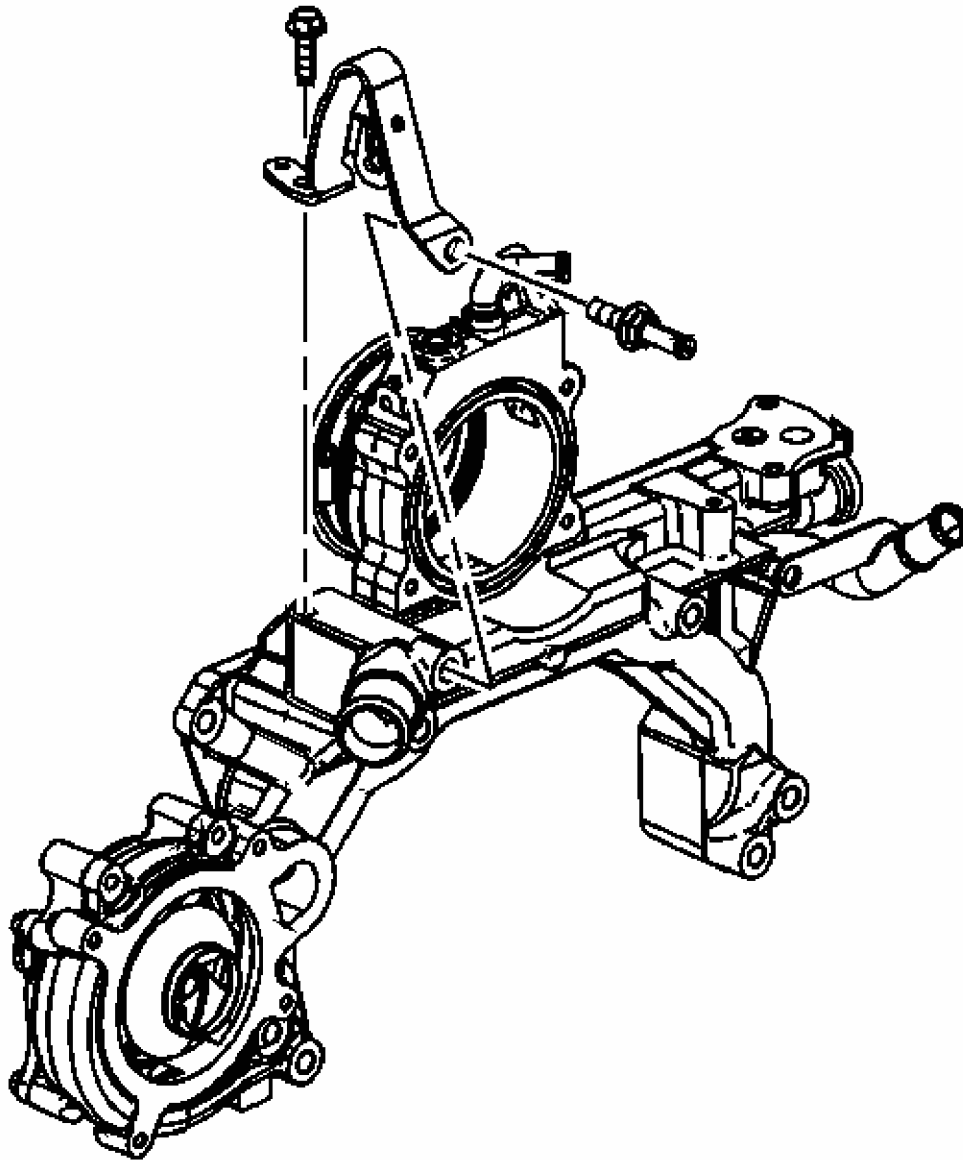
16. Remove the fuel rail bracket nut at the rear left lift bracket.



**Fig. 56: View Of Surge Tank Inlet Hose/Pipe**  
**Courtesy of GENERAL MOTORS CORP.**

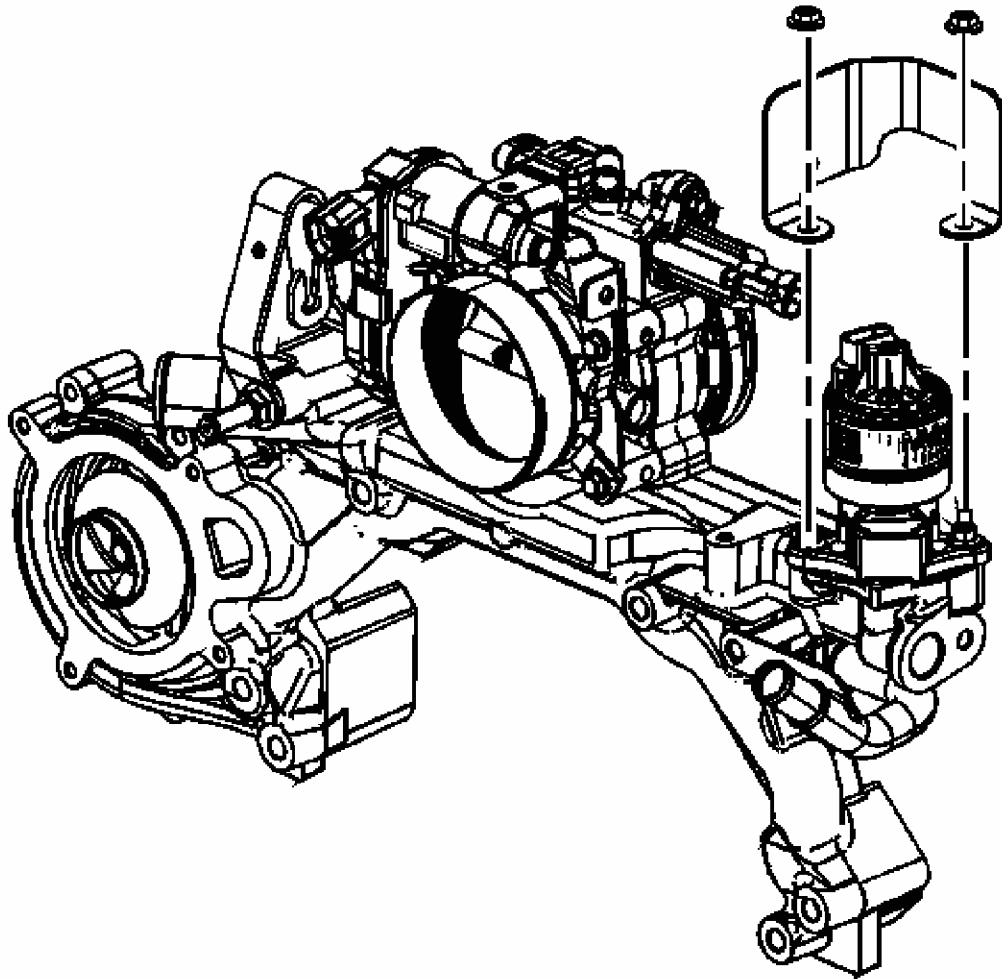
17. Reposition the surge tank inlet hose clamp at the fitting.
18. Remove the surge tank inlet hose from the fitting.





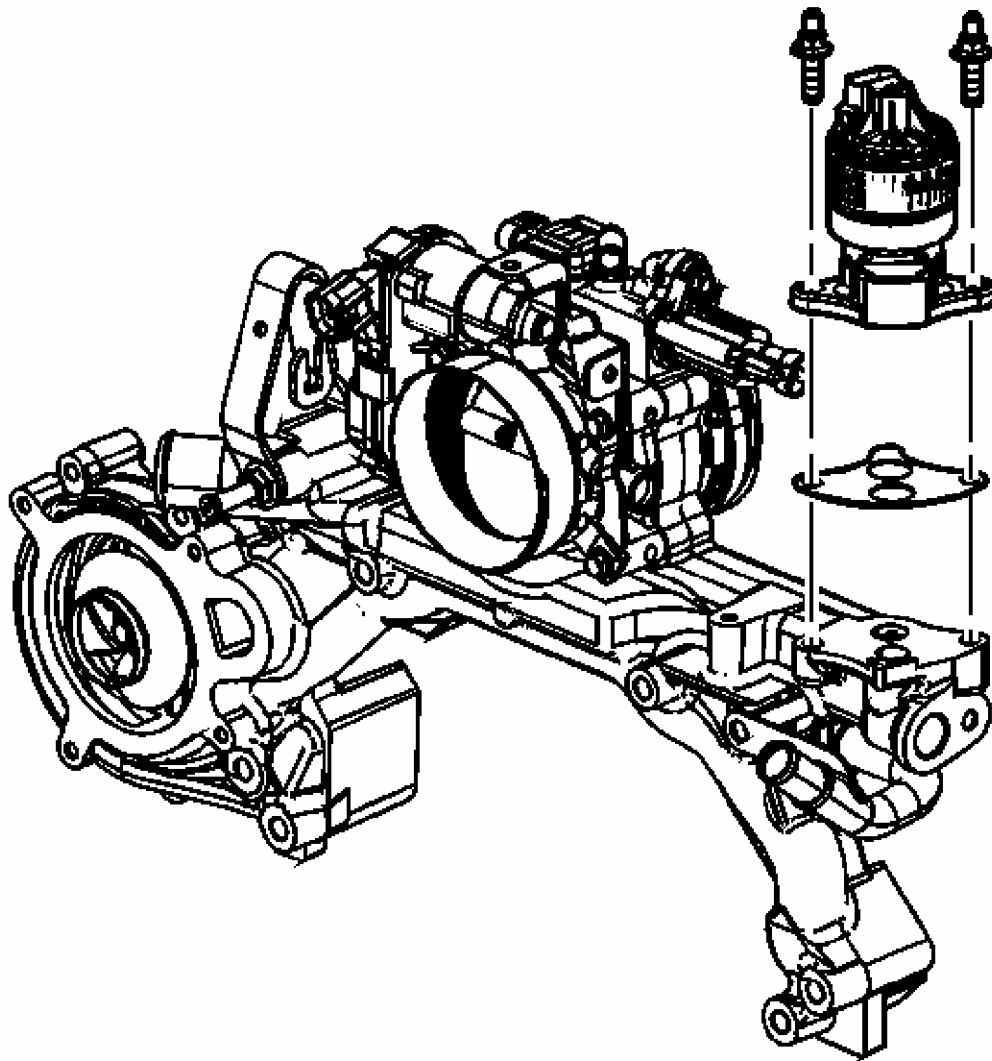
**Fig. 57: Identifying Engine Coolant Outlet Fitting**  
**Courtesy of GENERAL MOTORS CORP.**

19. Remove the engine coolant outlet fitting.
20. Remove the rear left lift bracket bolt.
21. Remove the rear left lift bracket.



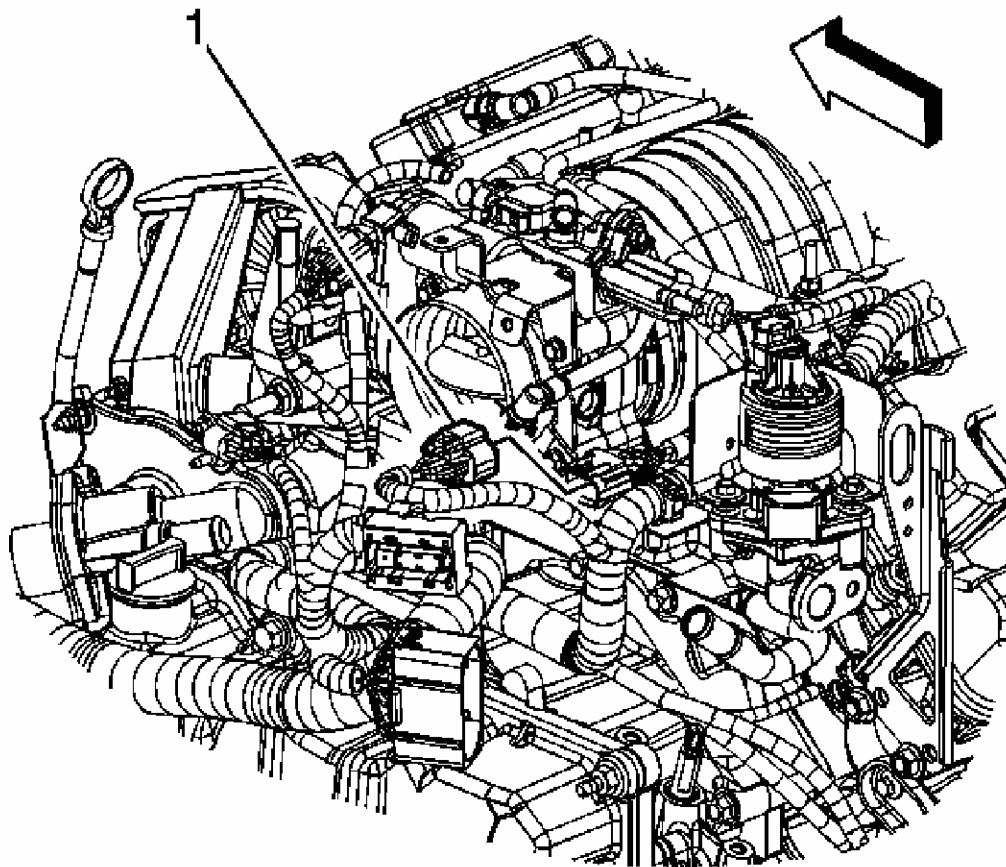
**Fig. 58: Identifying EGR Bracket Shield Nuts**  
**Courtesy of GENERAL MOTORS CORP.**

22. Remove the exhaust gas recirculation (EGR) valve shield nuts.
23. Remove the EGR valve shield.



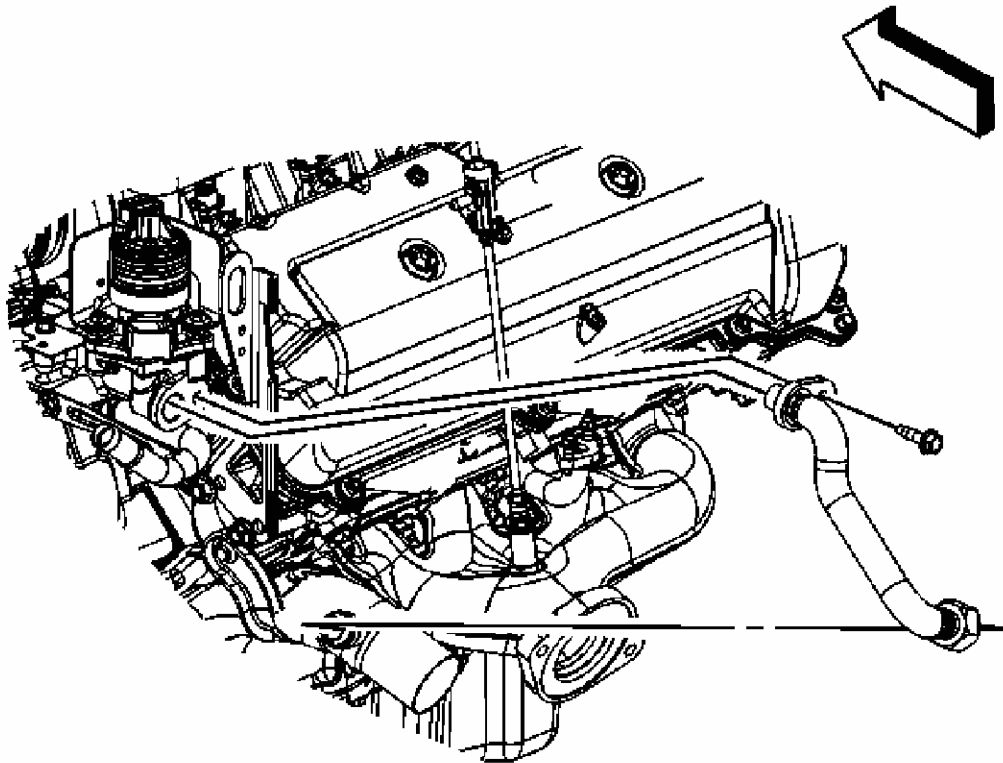
**Fig. 59: View Of EGR Valve Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

24. Remove the EGR valve bolts.
25. Remove the EGR valve.
26. Remove and discard the EGR valve gasket.



**Fig. 60: View Of Engine Harness Electrical Connectors**  
**Courtesy of GENERAL MOTORS CORP.**

27. Disconnect the engine harness electrical connector (1) from the engine valley electrical connector.

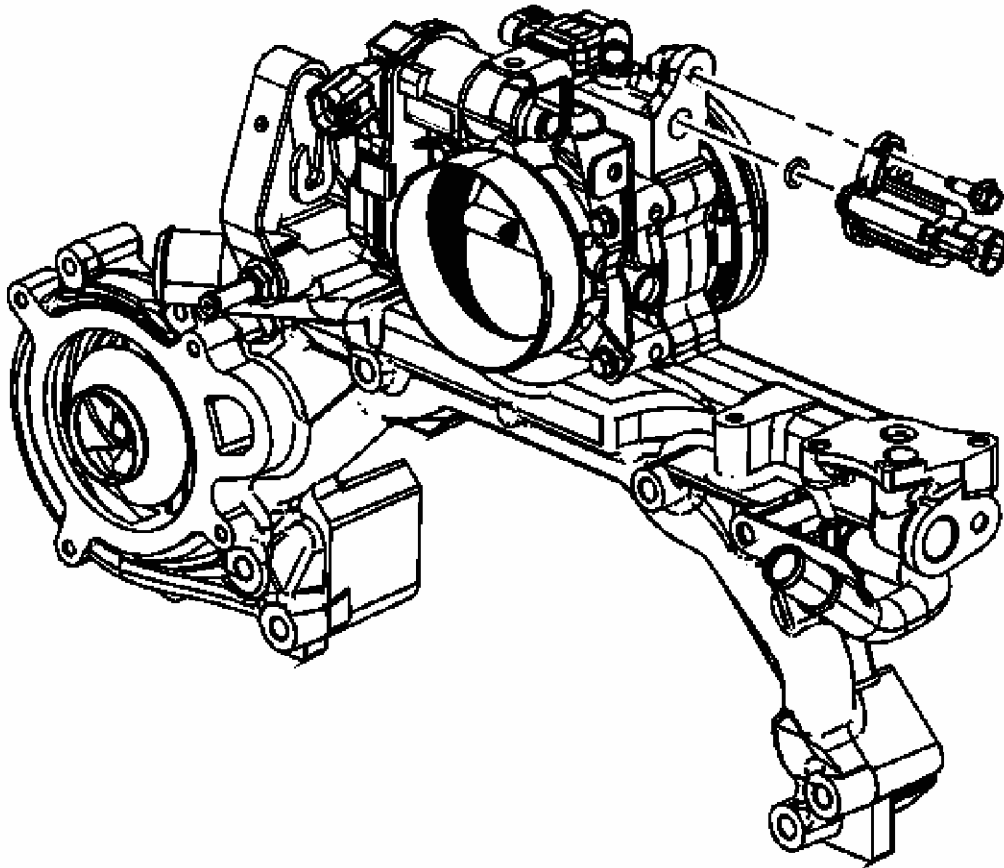


**Fig. 61: Identifying EGR Valve Inlet Pipe**  
**Courtesy of GENERAL MOTORS CORP.**

28. Disconnect the EGR inlet pipe nut from the exhaust manifold front pipe.

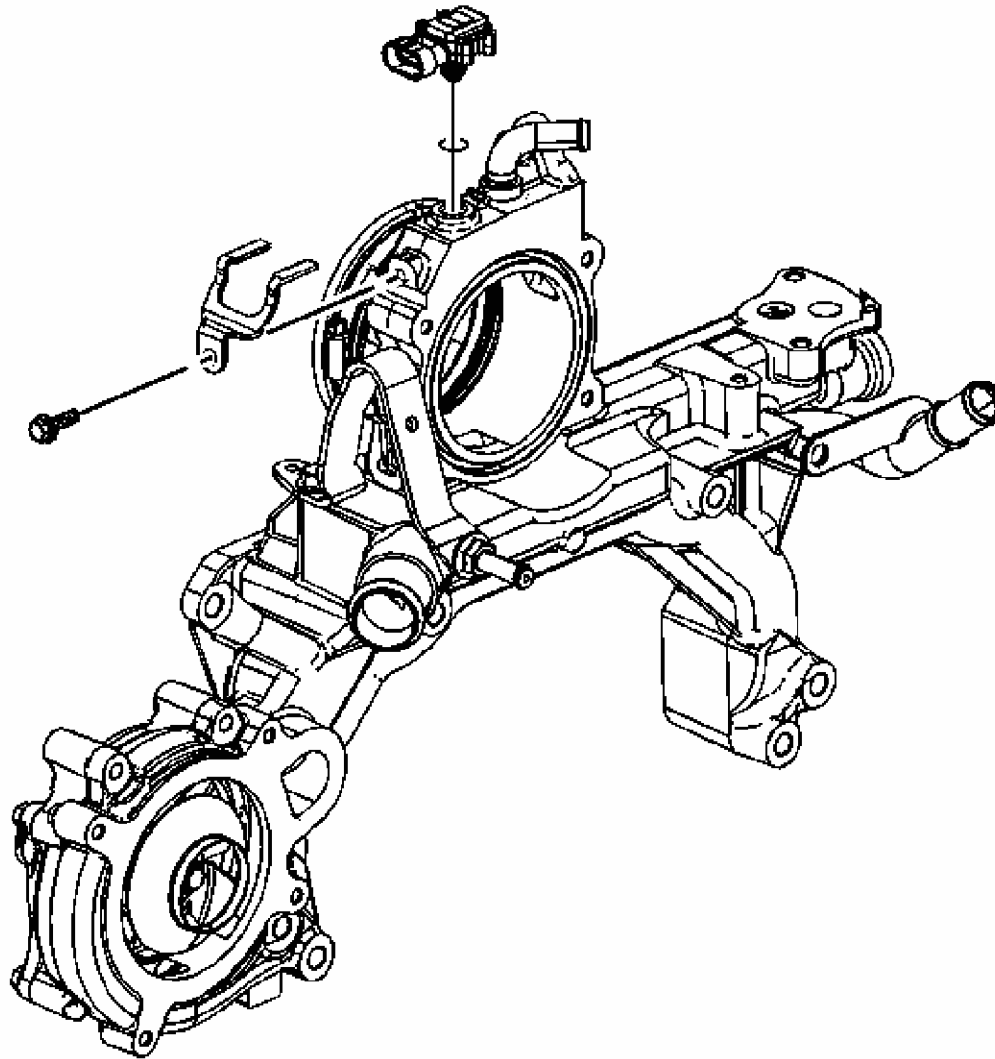
**IMPORTANT:** The EGR valve inlet pipe incorporates a crush seal connection at the water pump housing. The EGR valve inlet pipe must be replaced if disconnected from the water pump housing.

29. Remove the EGR inlet pipe bolt from the water pump housing.
30. Remove and discard the EGR inlet pipe.



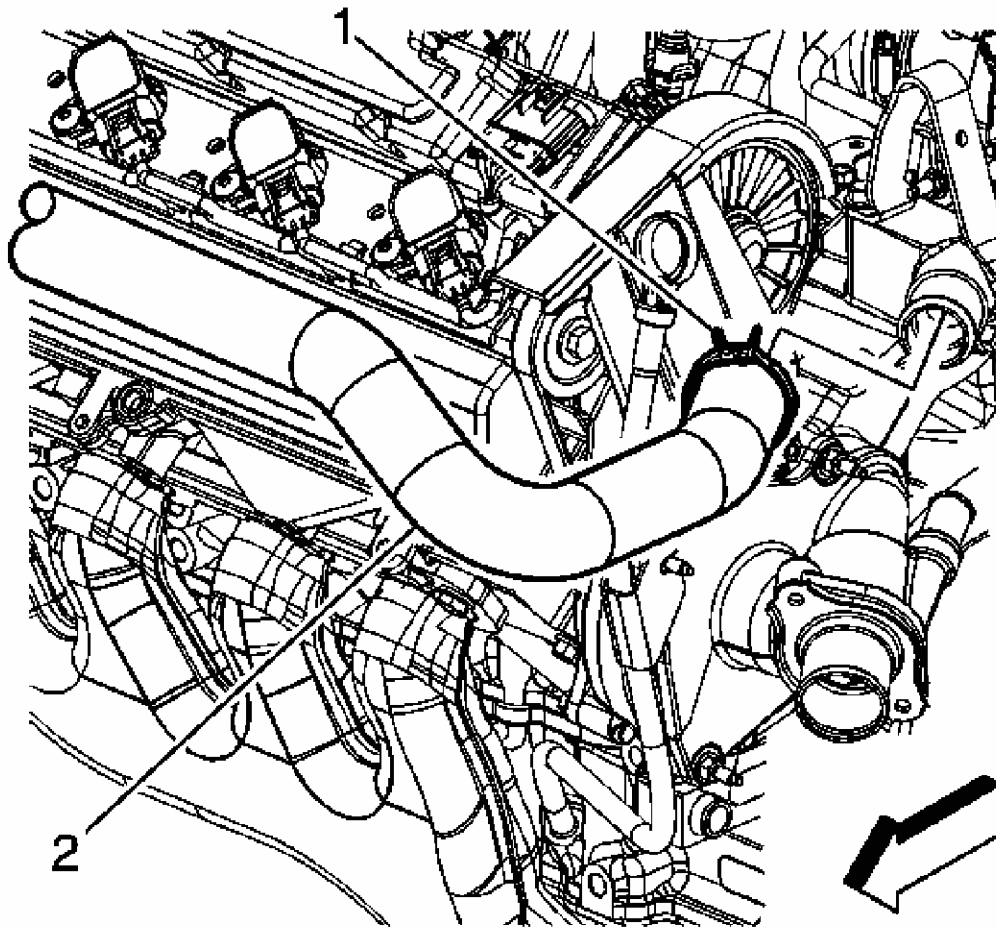
**Fig. 62: View Of EVAP Canister Purge Solenoid Valve & Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

31. Remove the evaporative emission (EVAP) canister purge solenoid valve bolt.
32. Remove the EVAP canister purge solenoid valve.



**Fig. 63: Identifying MAP Sensor Bracket & Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

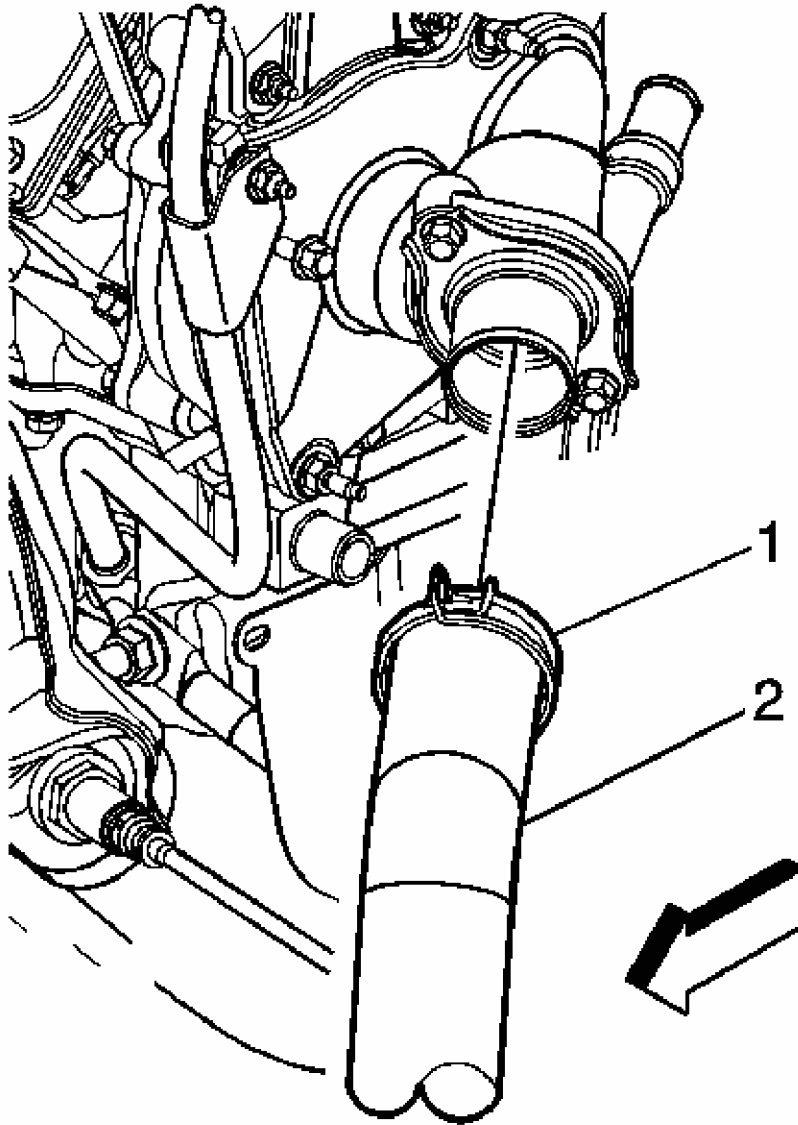
33. Remove the manifold absolute pressure (MAP) sensor bracket bolt.
34. Remove the MAP sensor bracket.
35. Remove the MAP sensor.



**Fig. 64: View Of Radiator Inlet Hose & Clamp**  
**Courtesy of GENERAL MOTORS CORP.**

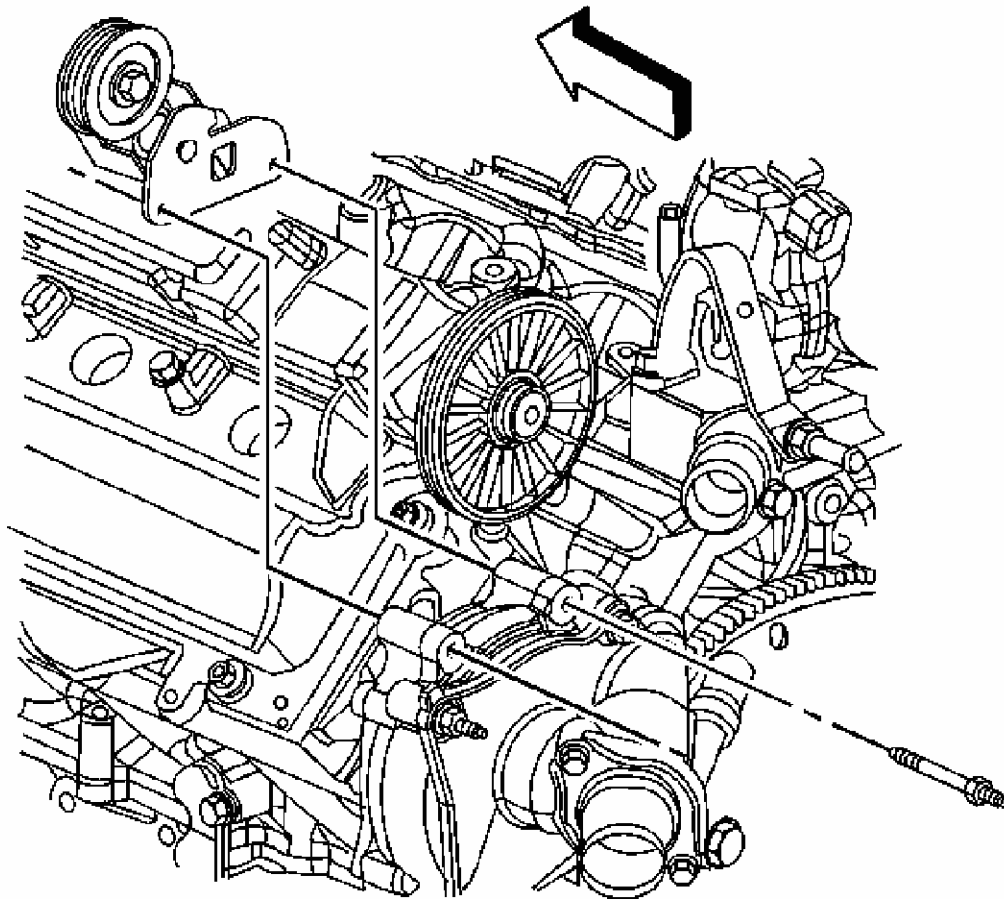
36. Using the **J 38185** , reposition the radiator inlet hose clamp (1) at the water pump housing.
37. Remove the radiator inlet hose (2) from the water pump housing.





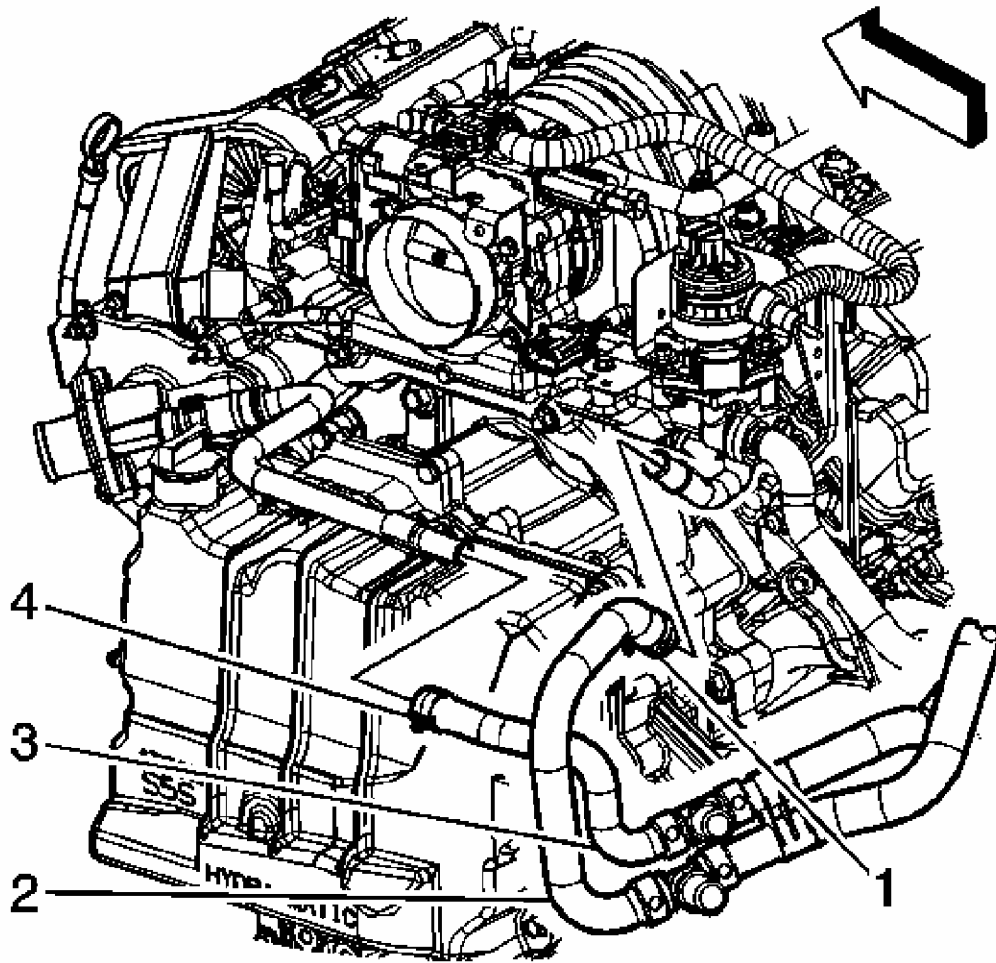
**Fig. 65: Identifying Radiator Outlet Hose**  
**Courtesy of GENERAL MOTORS CORP.**

38. Using the **J 38185** , reposition the radiator outlet hose clamp (1) at the thermostat housing.
39. Remove the radiator outlet hose (2) from the thermostat housing.



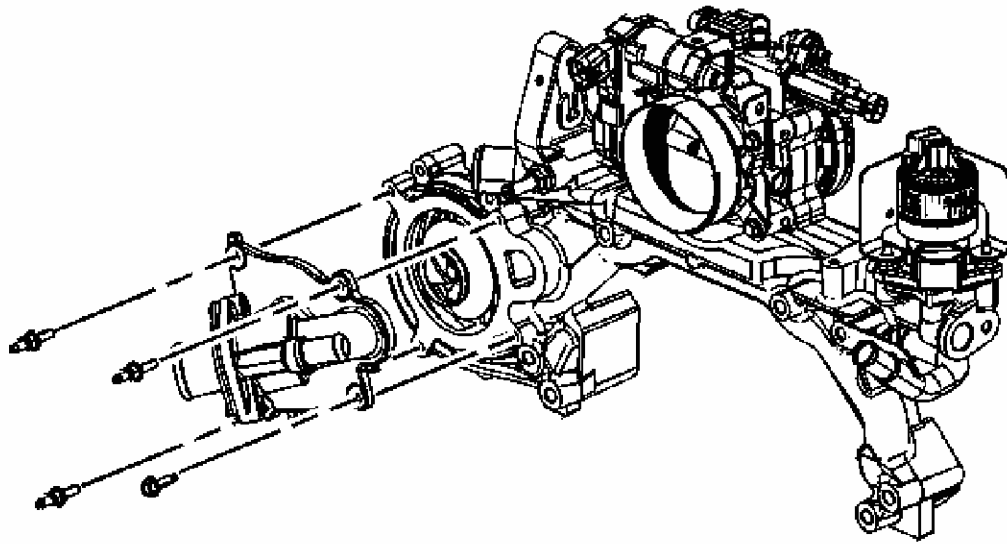
**Fig. 66: Identifying Water Pump Drive Belt Tensioner**  
**Courtesy of GENERAL MOTORS CORP.**

40. Remove the water pump belt tensioner studs.
41. Remove the water pump belt tensioner.



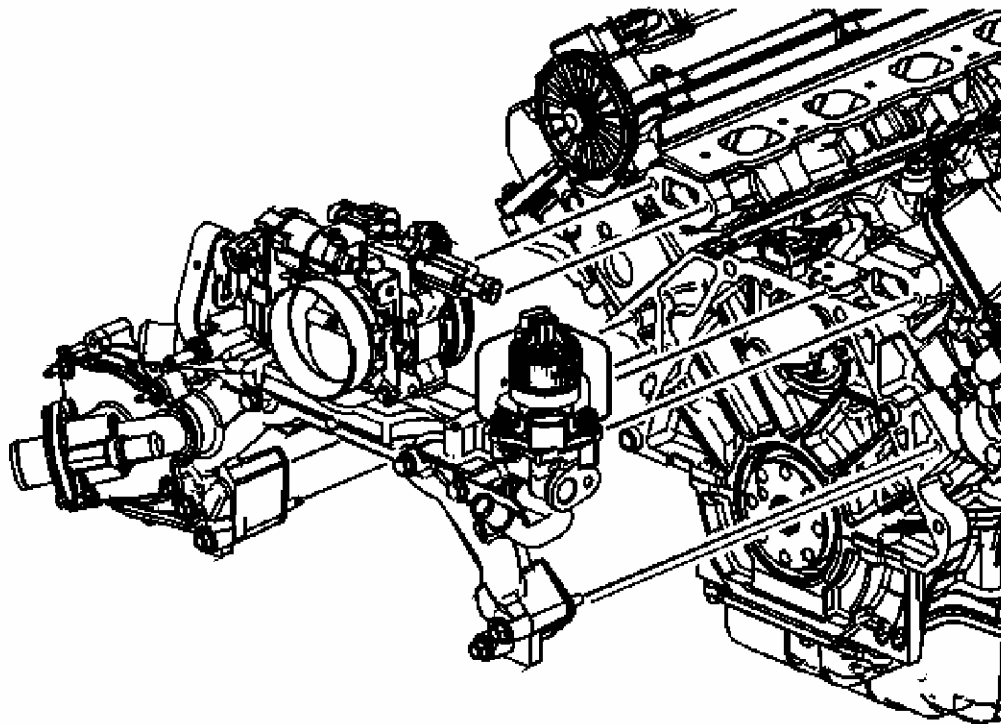
**Fig. 67: Identifying Heater Inlet & Outlet Hoses**  
**Courtesy of GENERAL MOTORS CORP.**

42. Reposition the heater outlet hose clamp (4) at the heater pipe.
43. Remove the heater outlet hose (3) from the heater pipe.



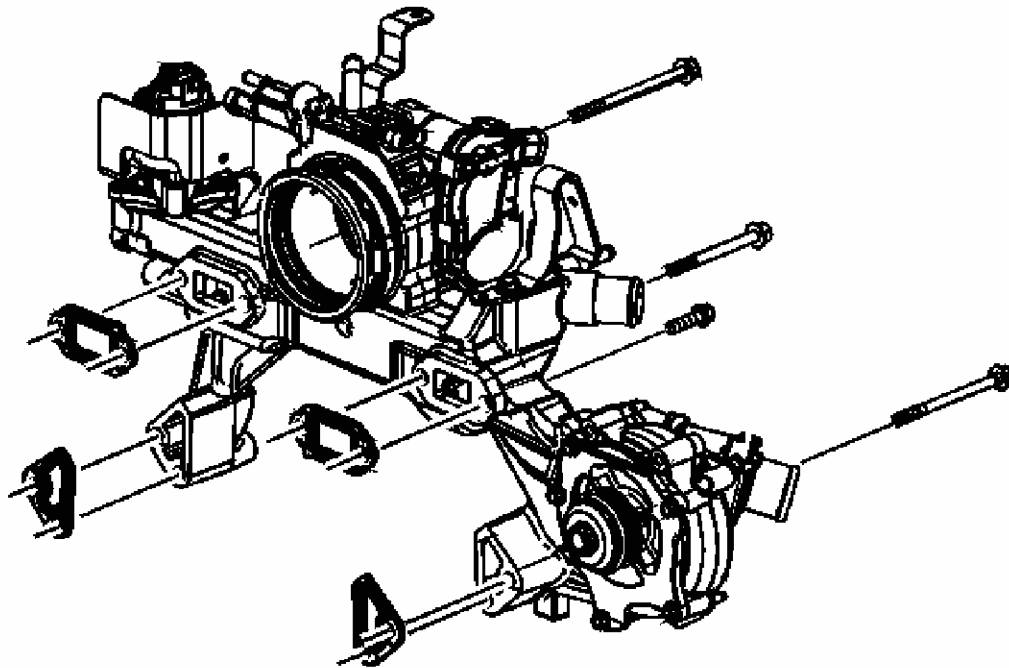
**Fig. 68: View Of Water Pump Cover, Bolt & Studs**  
**Courtesy of GENERAL MOTORS CORP.**

44. Remove the water pump cover bolt and studs.
45. Remove the water pump cover



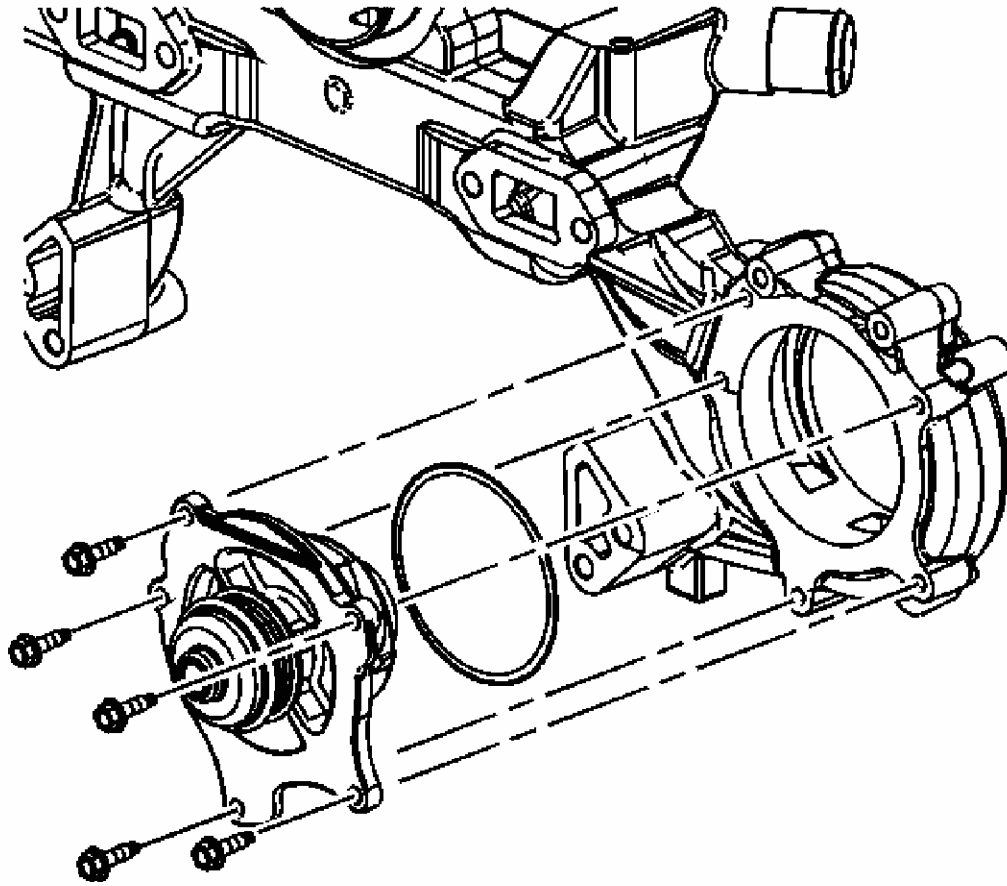
**Fig. 69: View Of Water Pump Housing**  
**Courtesy of GENERAL MOTORS CORP.**

46. Loosen the water pump housing bolts.
47. Remove the water pump housing.



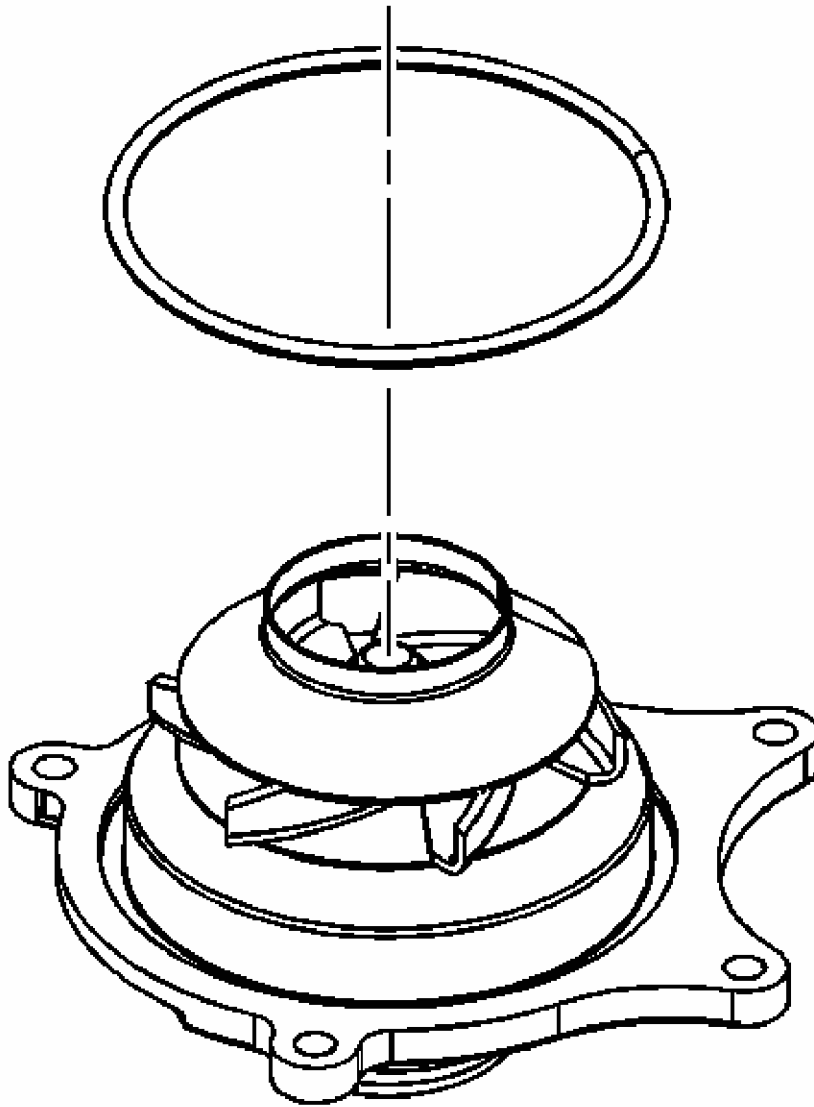
**Fig. 70: Removing/Installing Water Pump Housing Gaskets & Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

48. Remove the water pump housing gaskets and bolts.



**Fig. 71: Removing/Installing Water Pump & Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

49. With the water pump housing on the bench, remove the water pump bolts.
50. Remove the water pump from the water pump housing.

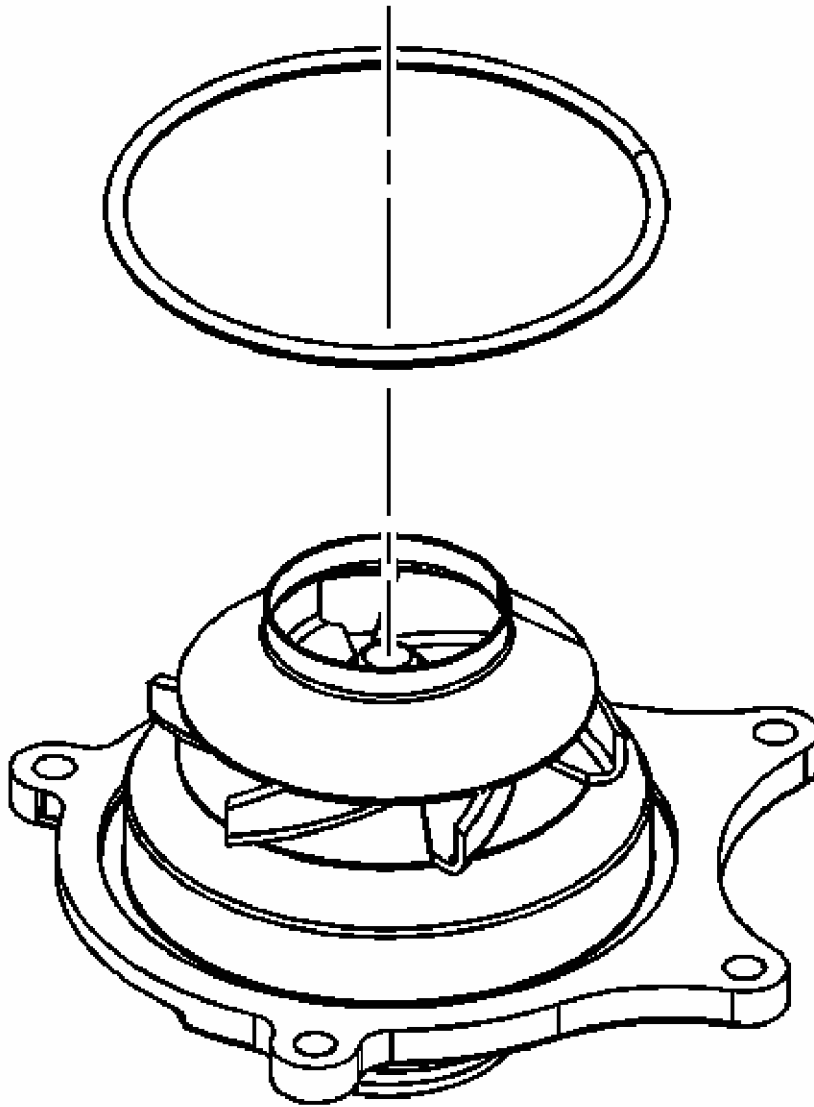


**Fig. 72: Identifying Water Pump O-Ring Seal**  
**Courtesy of GENERAL MOTORS CORP.**

51. Remove and discard the water pump O-ring.

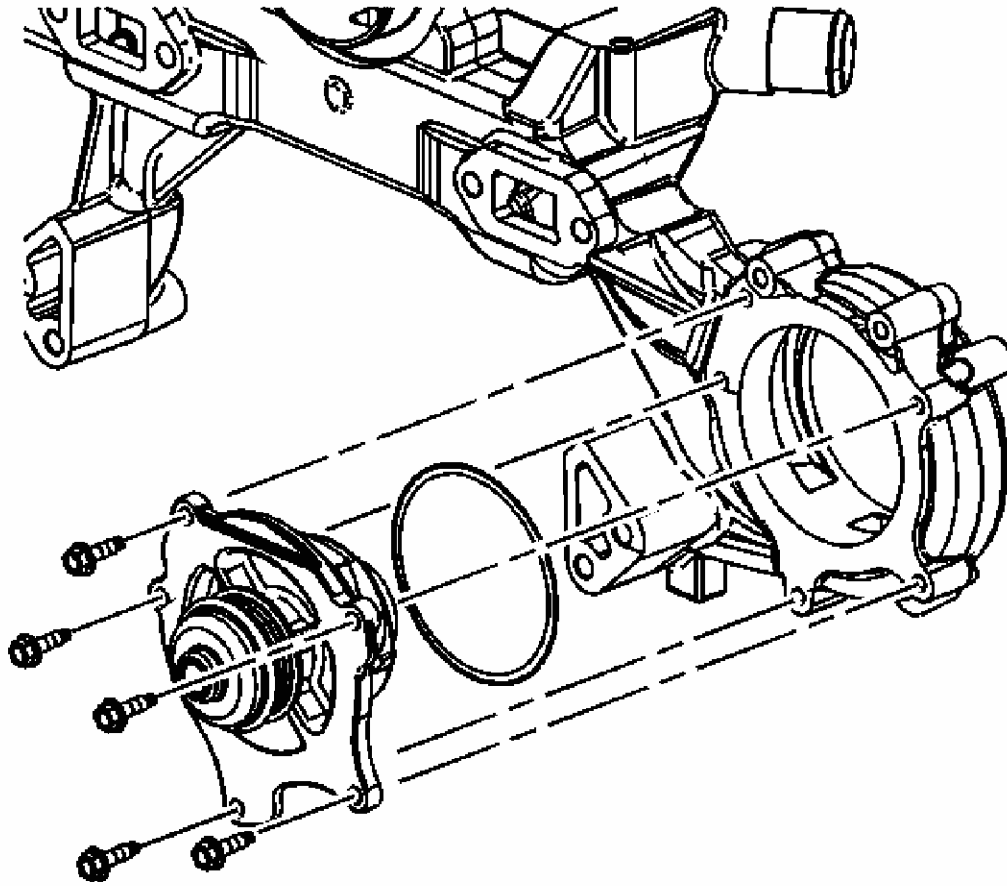
**Installation Procedure**





**Fig. 73: Identifying Water Pump O-Ring Seal**  
**Courtesy of GENERAL MOTORS CORP.**

1. Install a NEW water pump O-ring to the water pump.



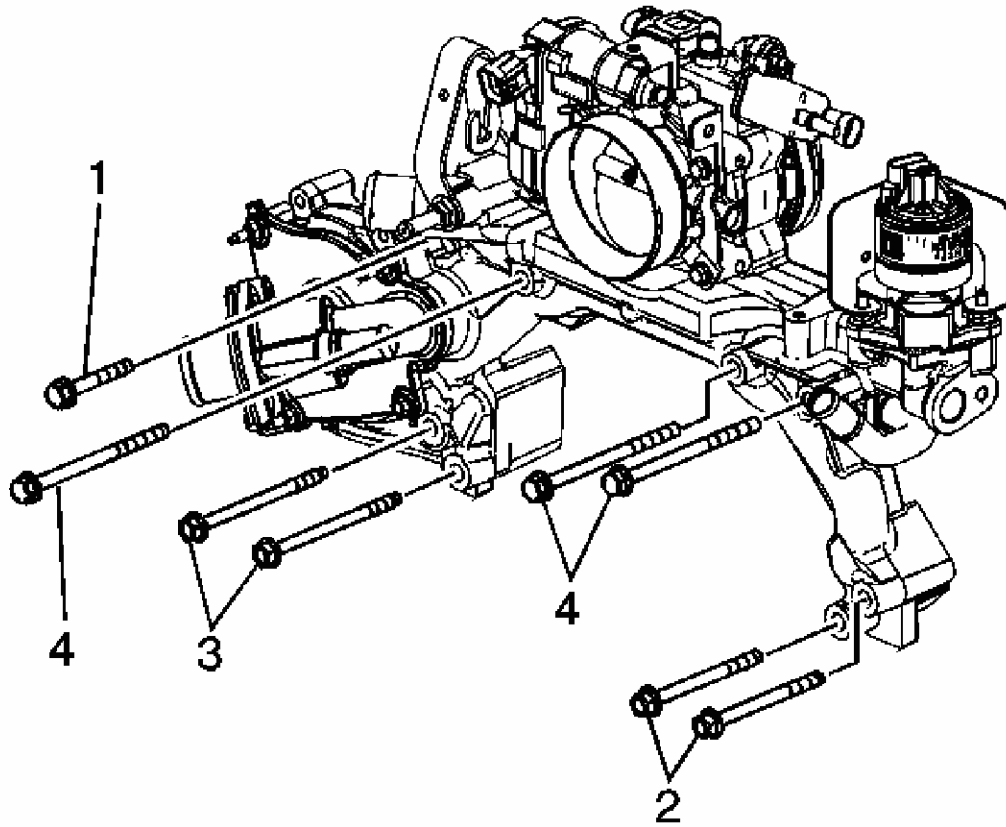
**Fig. 74: Removing/Installing Water Pump & Bolts**  
Courtesy of GENERAL MOTORS CORP.

2. Install the water pump.

**NOTE:** Refer to Fastener Notice .

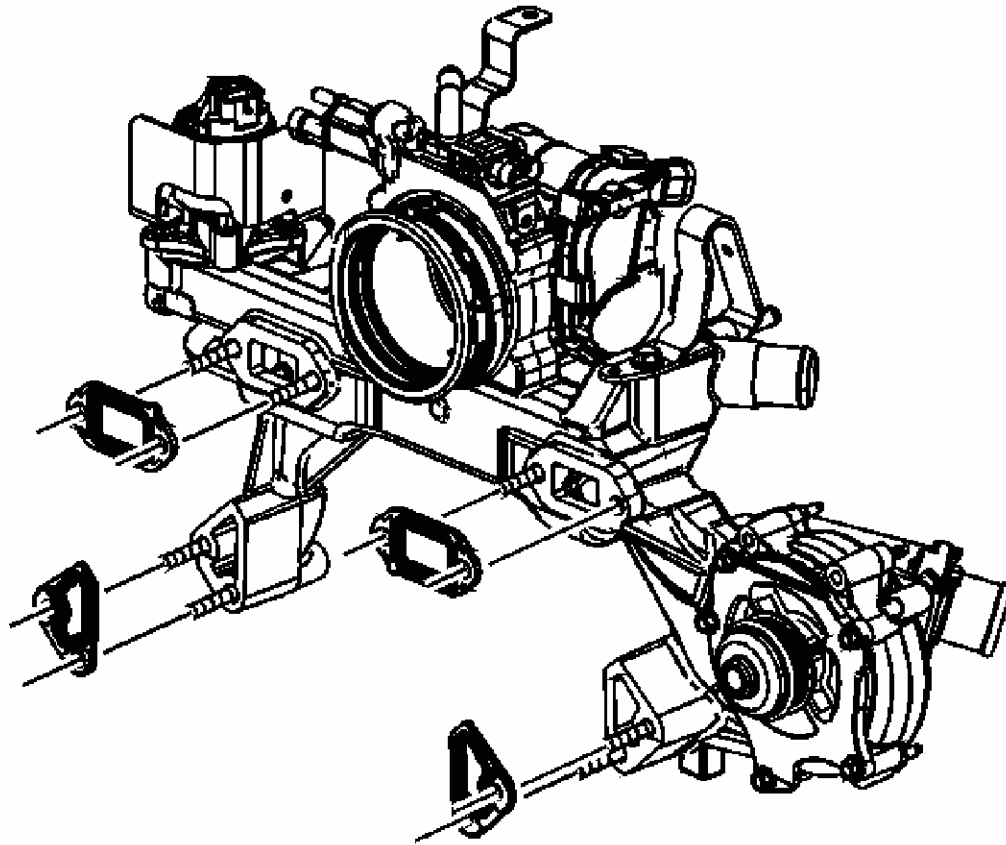
3. Install the water pump bolts.

**Tighten:** Tighten the bolts to 10 N.m (89 lb in).



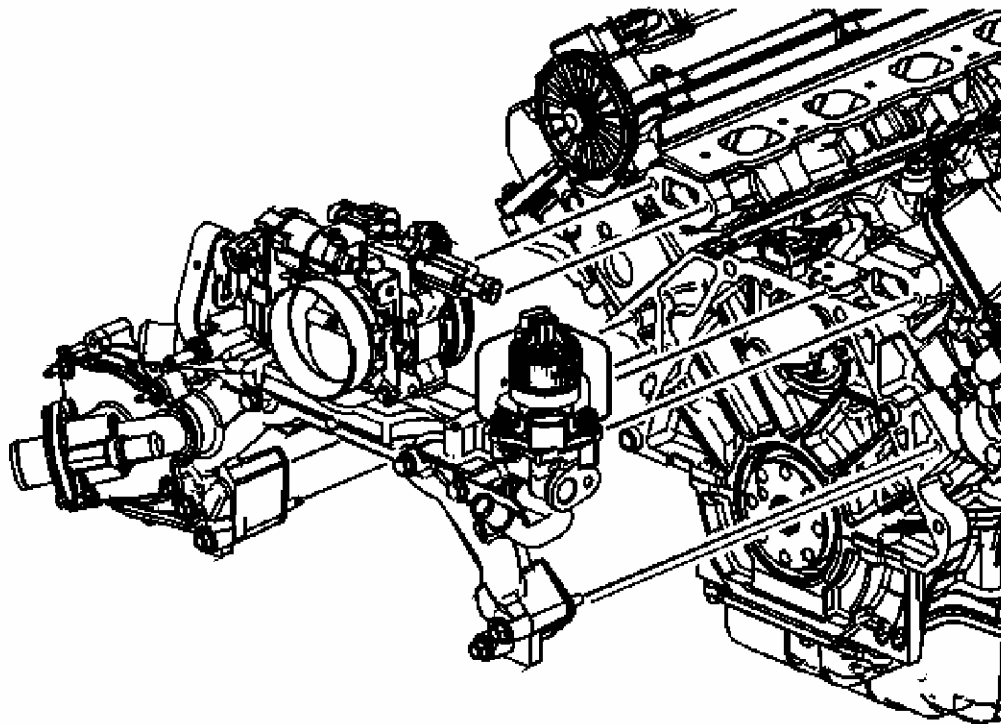
**Fig. 75: Identifying Water Pump Housing & Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

4. With the water pump housing on the bench, install the bolts in the locations shown.
  - Bolt (1) length 40.7 mm (1.6024 in).
  - Bolts (2) length 92.0 mm (3.6220 in).
  - Bolts (3) length 109.0 mm (4.2913 in).
  - Bolts (4) length 115.0 mm (4.5276 in).



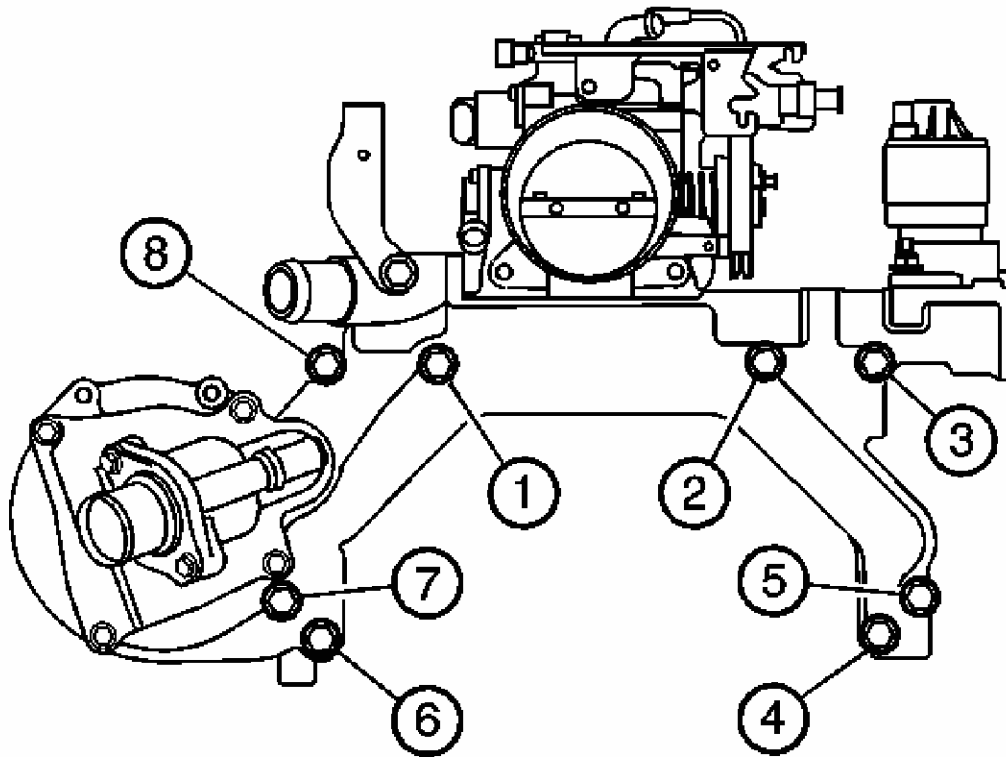
**Fig. 76: Removing/Installing Water Pump Housing Gaskets & Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

5. With the housing still on the bench, install the NEW water pump housing gasket onto the bolts.



**Fig. 77: View Of Water Pump Housing**  
**Courtesy of GENERAL MOTORS CORP.**

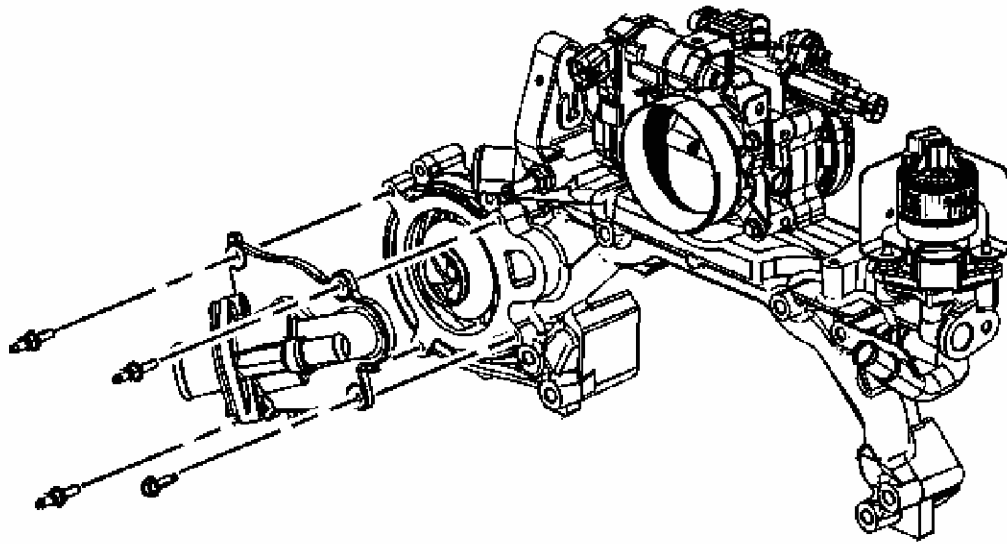
6. Position the water pump housing to the engine and hand start the bolts.



**Fig. 78: View of Water Crossover Bolts**  
Courtesy of GENERAL MOTORS CORP.

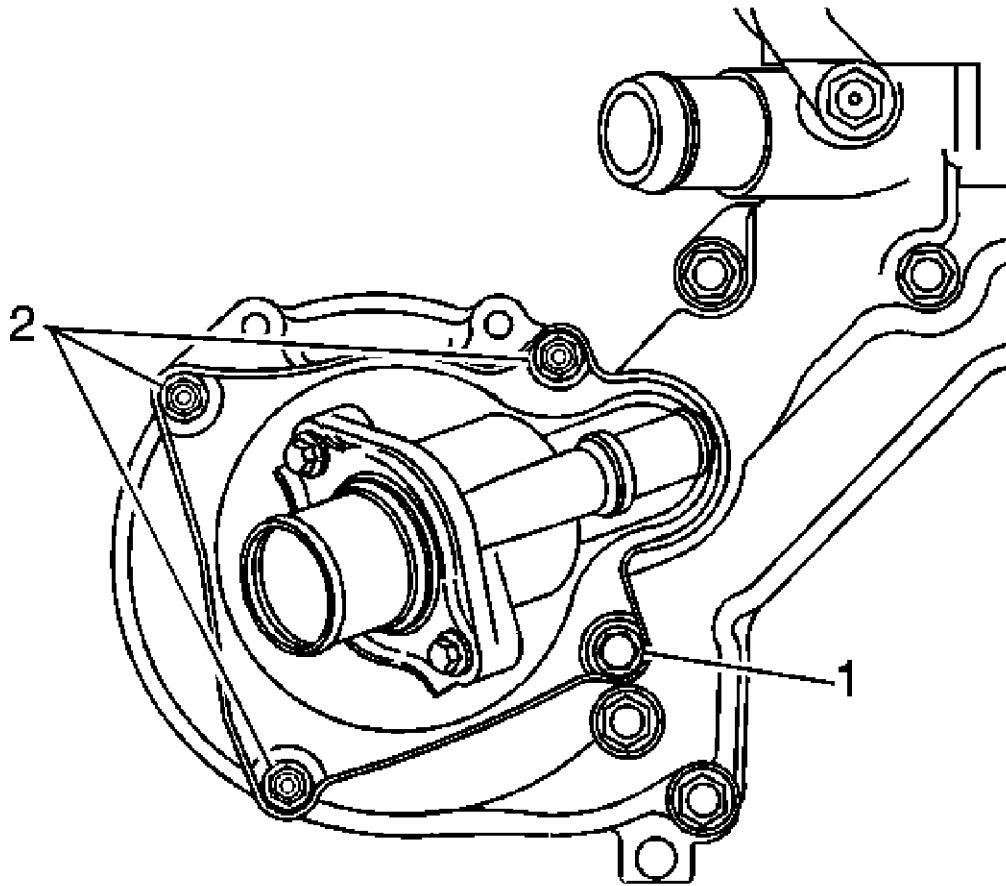
7. Tighten the water pump housing bolts.

**Tighten:** Tighten the bolts in the sequence shown to 25 N.m (18 lb ft).



**Fig. 79: View Of Water Pump Cover, Bolt & Studs**  
**Courtesy of GENERAL MOTORS CORP.**

8. Install the water pump cover.



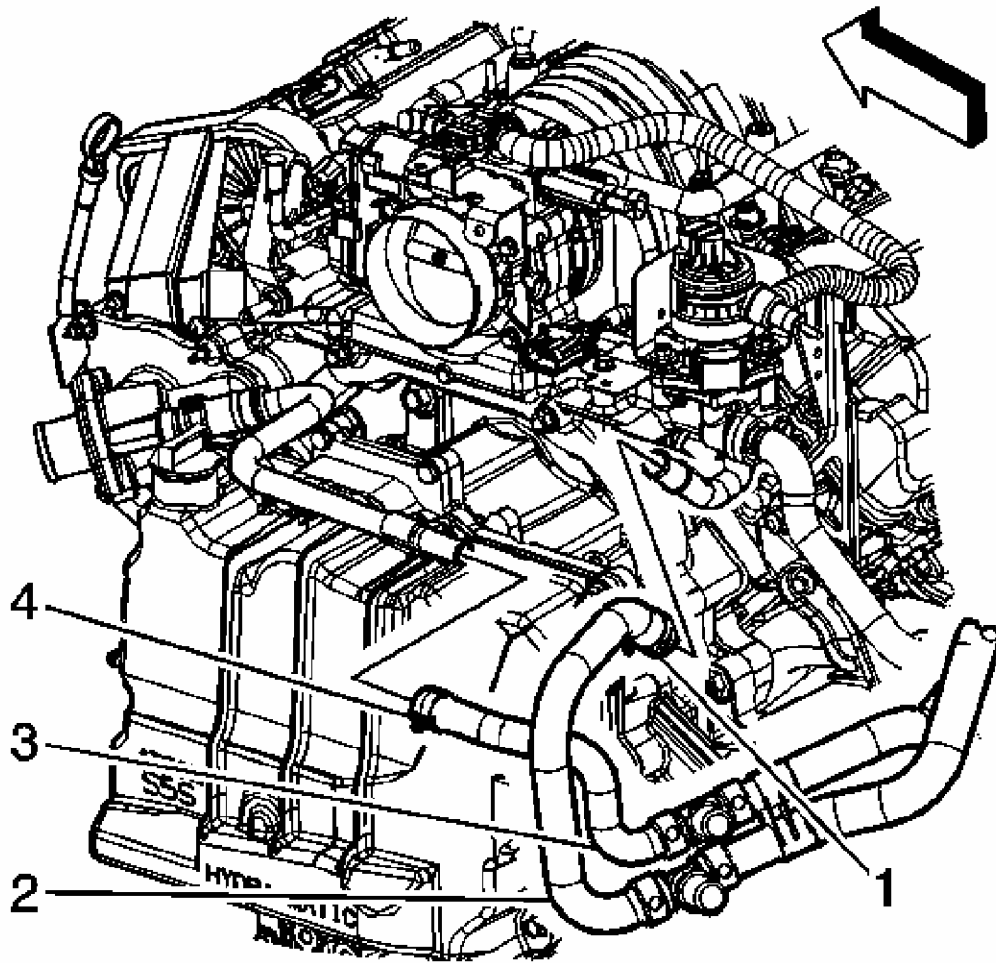
**Fig. 80: Illustrating Proper Bolt & Stud Position**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** Ensure the bolt is installed in the lower inboard position (1) and the studs are installed in the remaining position (2).

9. Install the water pump cover bolt and studs.

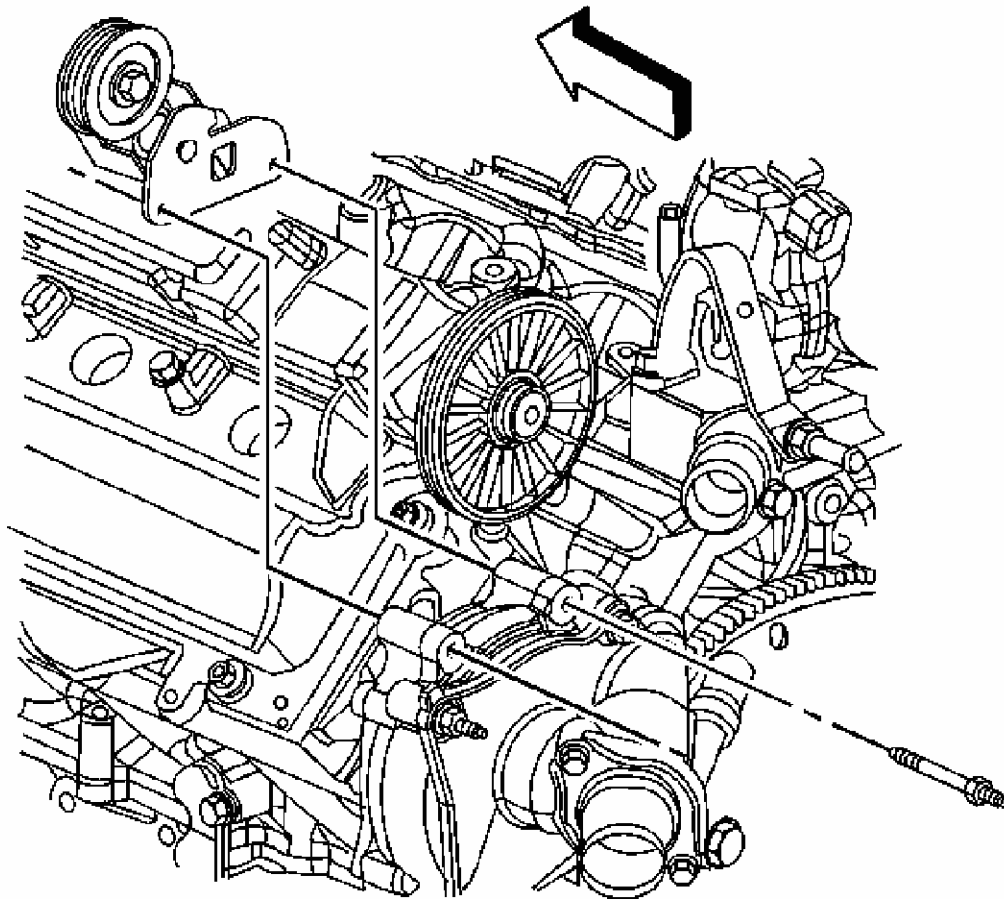
**Tighten:** Tighten the bolt/studs to 10 N.m (89 lb in).





**Fig. 81: Identifying Heater Inlet & Outlet Hoses**  
**Courtesy of GENERAL MOTORS CORP.**

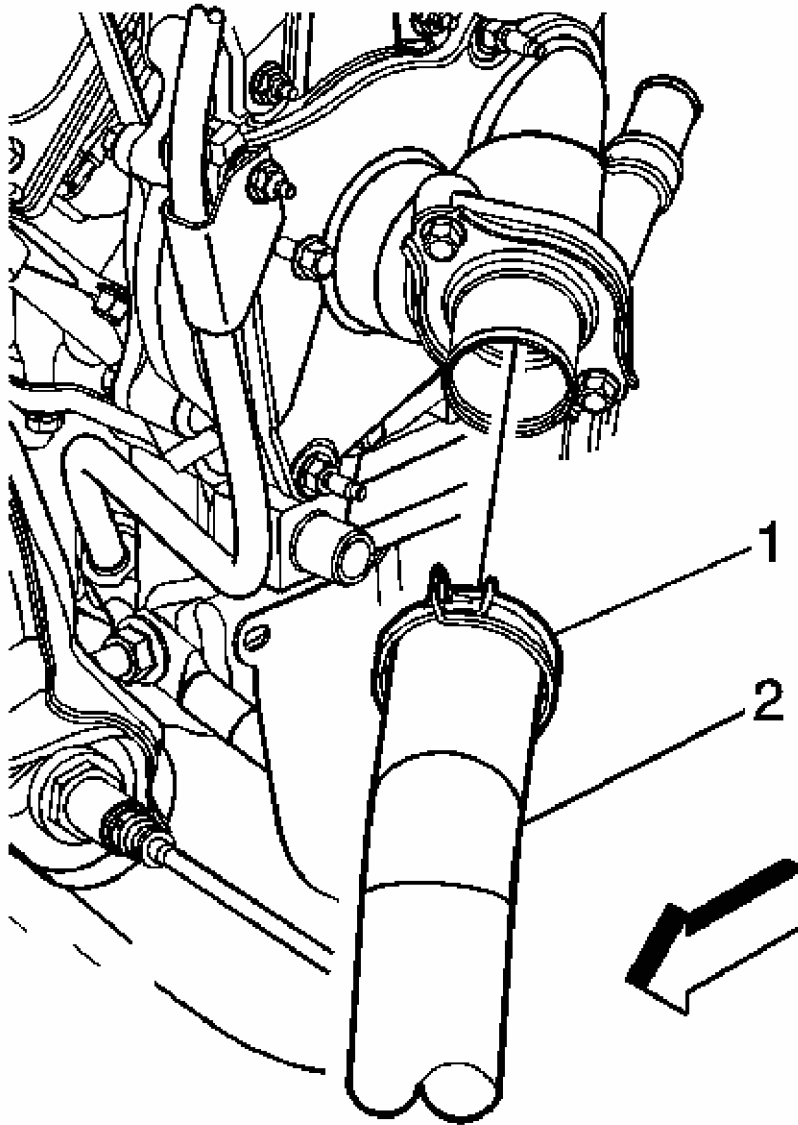
10. Install the heater outlet hose (3) to the heater pipe.
11. Position the heater outlet hose clamp (4) at the heater pipe.



**Fig. 82: Identifying Water Pump Drive Belt Tensioner**  
**Courtesy of GENERAL MOTORS CORP.**

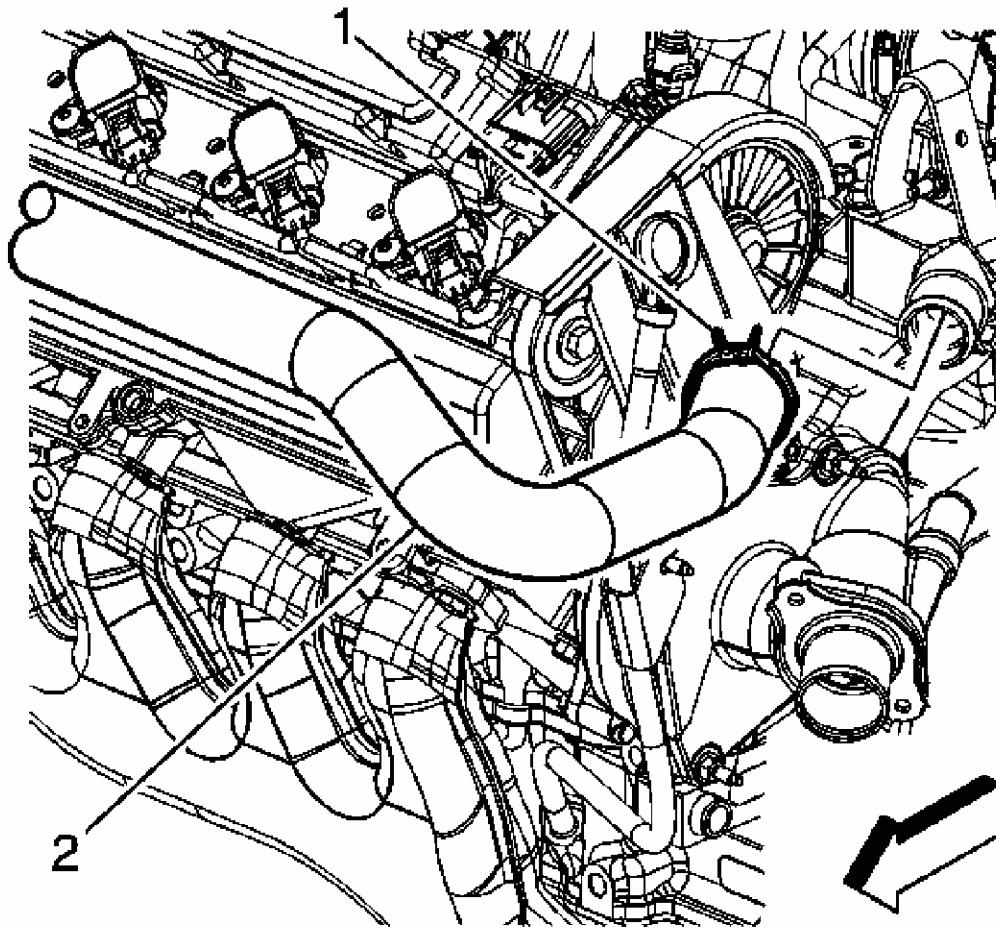
12. Position the water pump belt tensioner.
13. Install the water pump belt tensioner studs.

**Tighten:** Tighten the studs to 10 N.m (89 lb in).



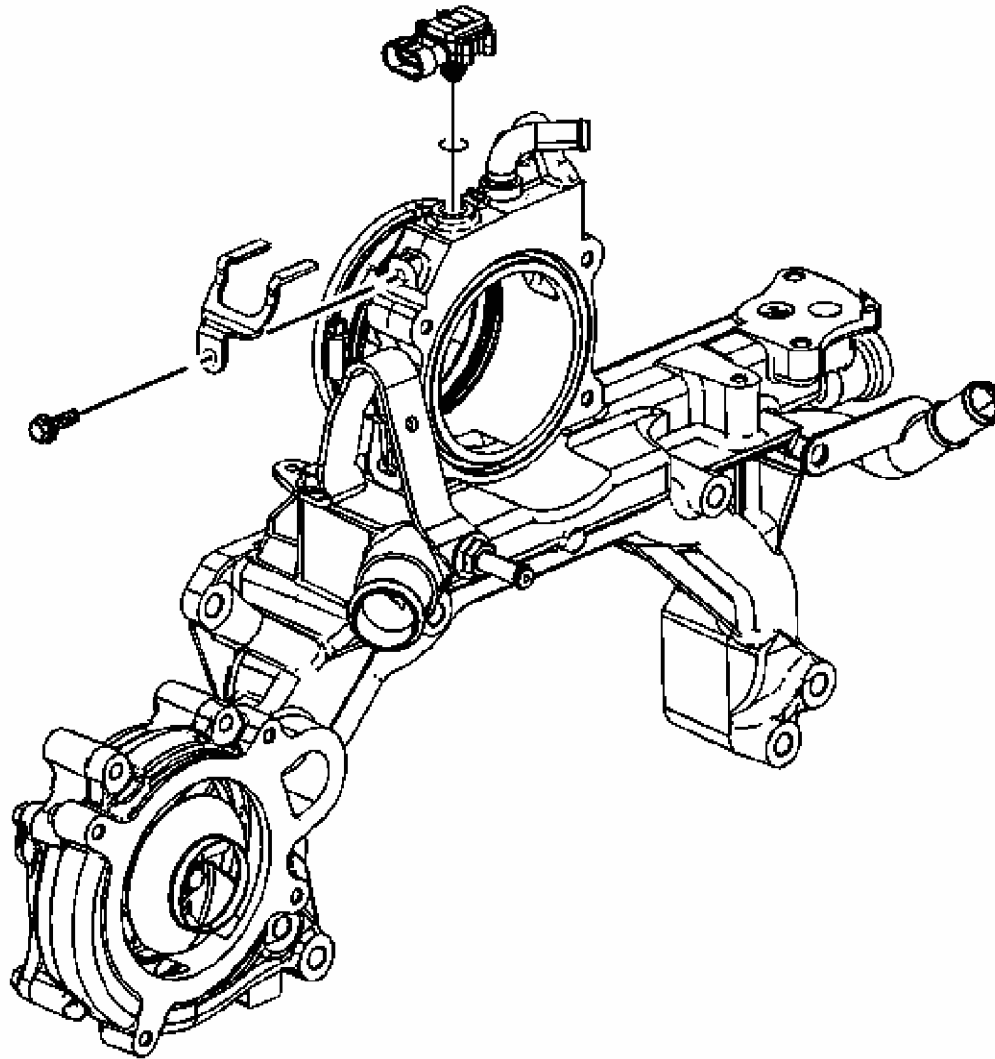
**Fig. 83: Identifying Radiator Outlet Hose**  
**Courtesy of GENERAL MOTORS CORP.**

14. Install the radiator outlet hose (2) to the thermostat housing.
15. Using the J 38185 , position the radiator outlet hose clamp (1) at the thermostat housing.



**Fig. 84: View Of Radiator Inlet Hose & Clamp**  
**Courtesy of GENERAL MOTORS CORP.**

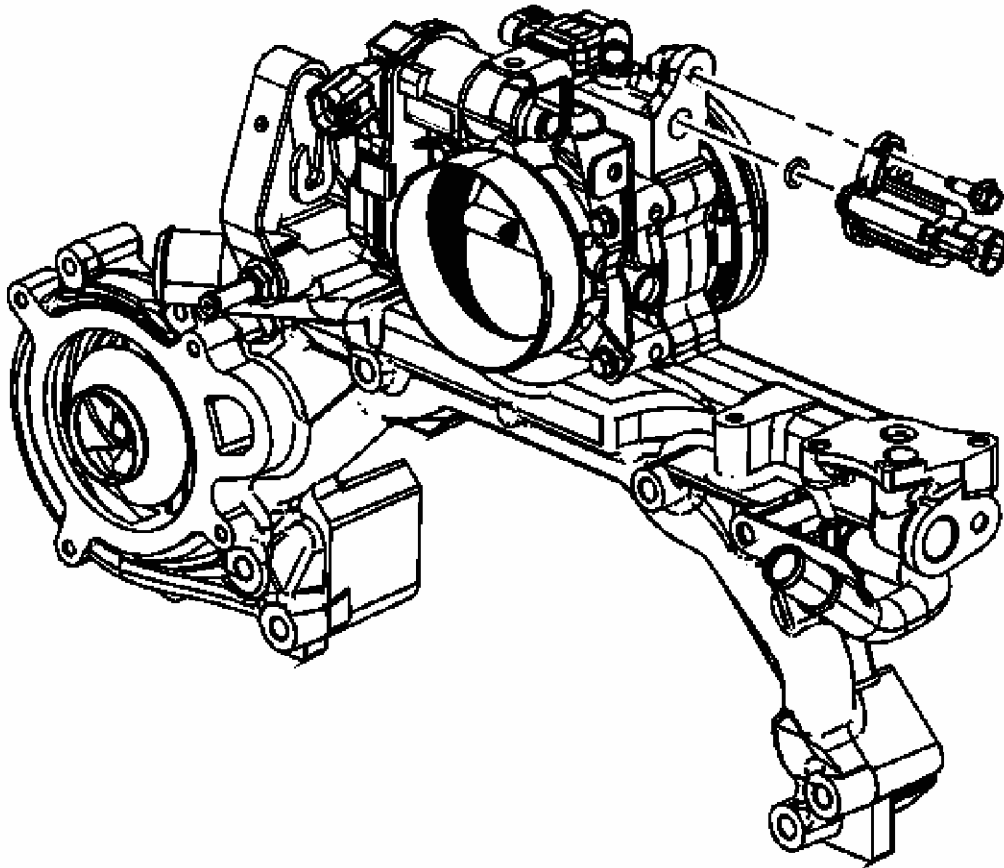
16. Install the radiator inlet hose (2) to the water pump housing.
17. Using the **J 38185** , position the radiator inlet hose clamp (1) at the water pump housing.



**Fig. 85: Identifying MAP Sensor Bracket & Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

18. Install the MAP sensor.
19. Install the MAP sensor bracket.
20. Install the MAP sensor bracket bolt.

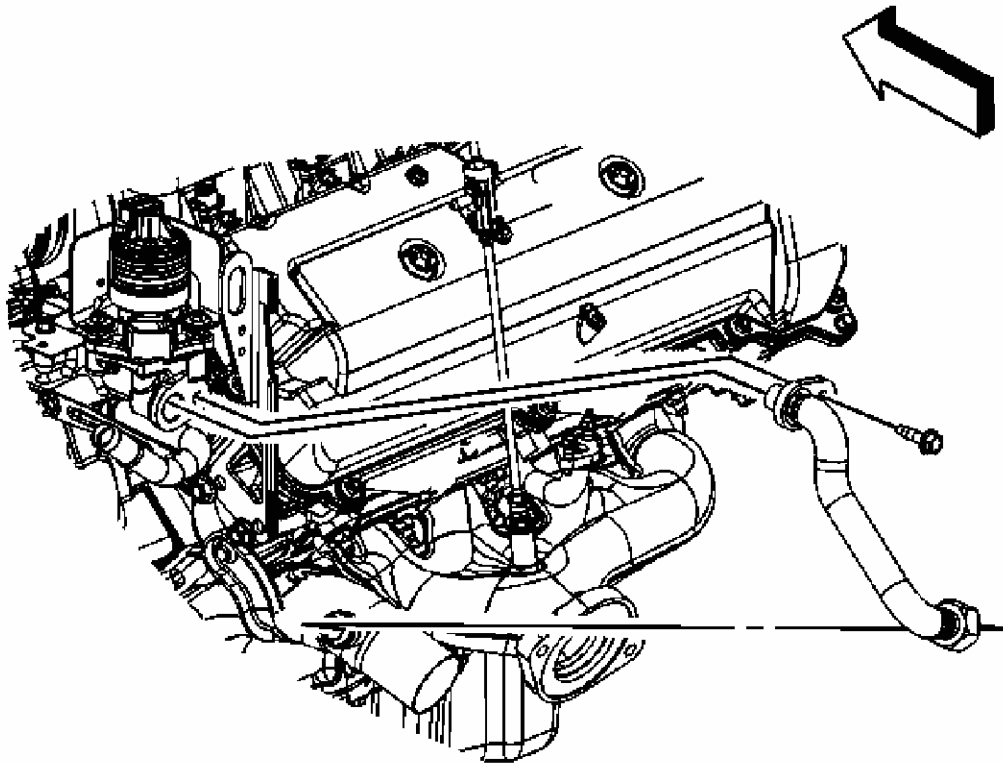
**Tighten:** Tighten the bolt to 10 N.m (89 lb in).



**Fig. 86: View Of EVAP Canister Purge Solenoid Valve & Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

21. Install the EVAP canister purge solenoid valve.
22. Install the EVAP canister purge solenoid valve bolt.

**Tighten:** Tighten the bolt to 10 N.m (89 lb in).



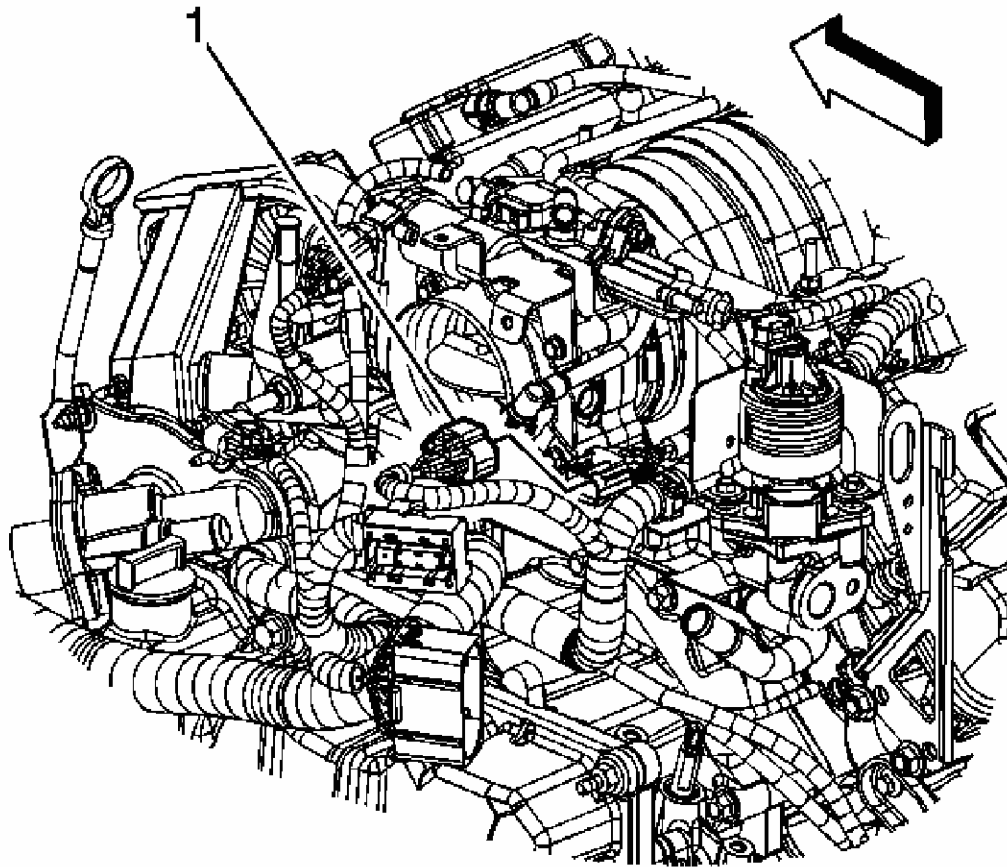
**Fig. 87: Identifying EGR Valve Inlet Pipe**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** The EGR valve inlet pipe incorporates a crush seal connection at the water pump housing. The EGR valve inlet pipe must be replaced if disconnected from the water pump housing.

23. Hand start the NEW EGR inlet pipe nut at the exhaust manifold front pipe.
24. Install the EGR inlet pipe and bolt to the water pump housing.

**Tighten:**

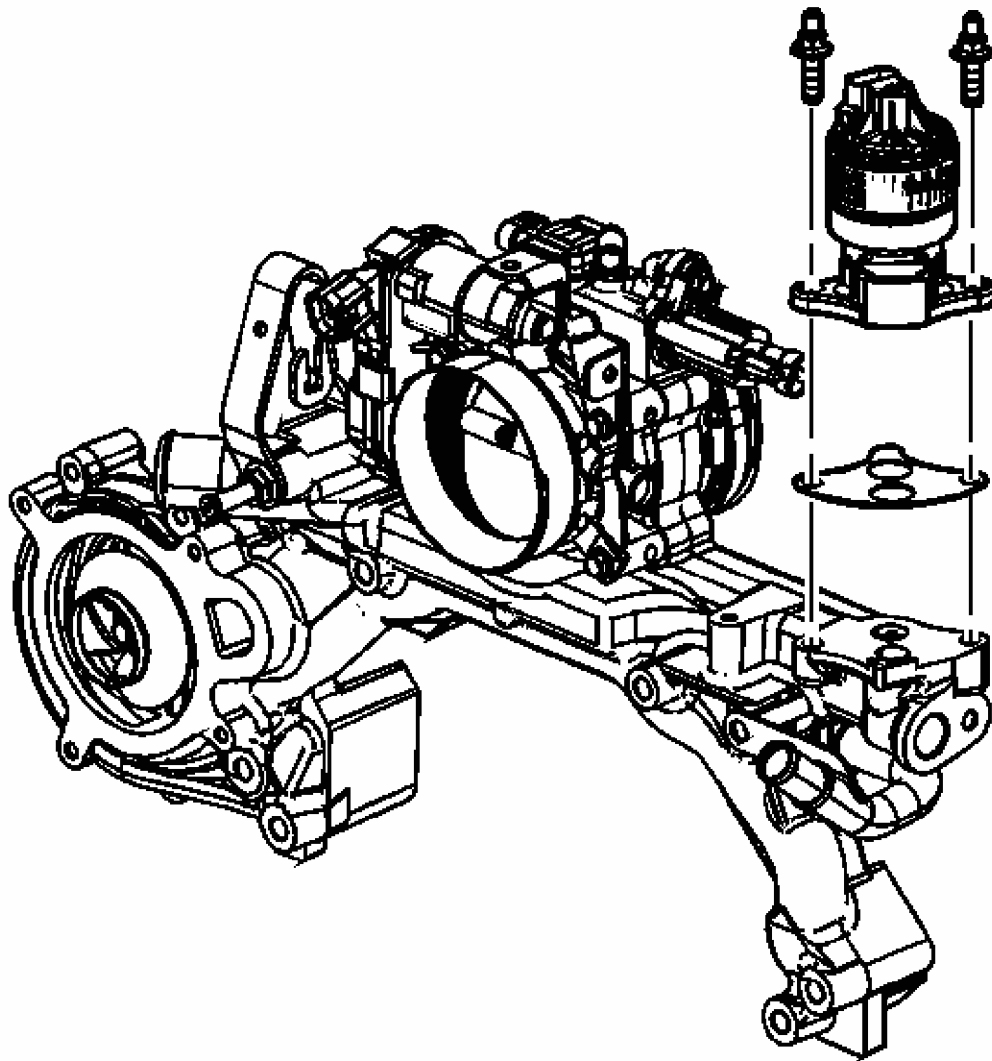
- Tighten the nut to 60 N.m (44 lb ft).
- Tighten the bolt to 25 N.m (18 lb ft).



**Fig. 88: View Of Engine Harness Electrical Connectors**  
**Courtesy of GENERAL MOTORS CORP.**

25. Connect the engine harness electrical connector (1) to the engine valley electrical connector.

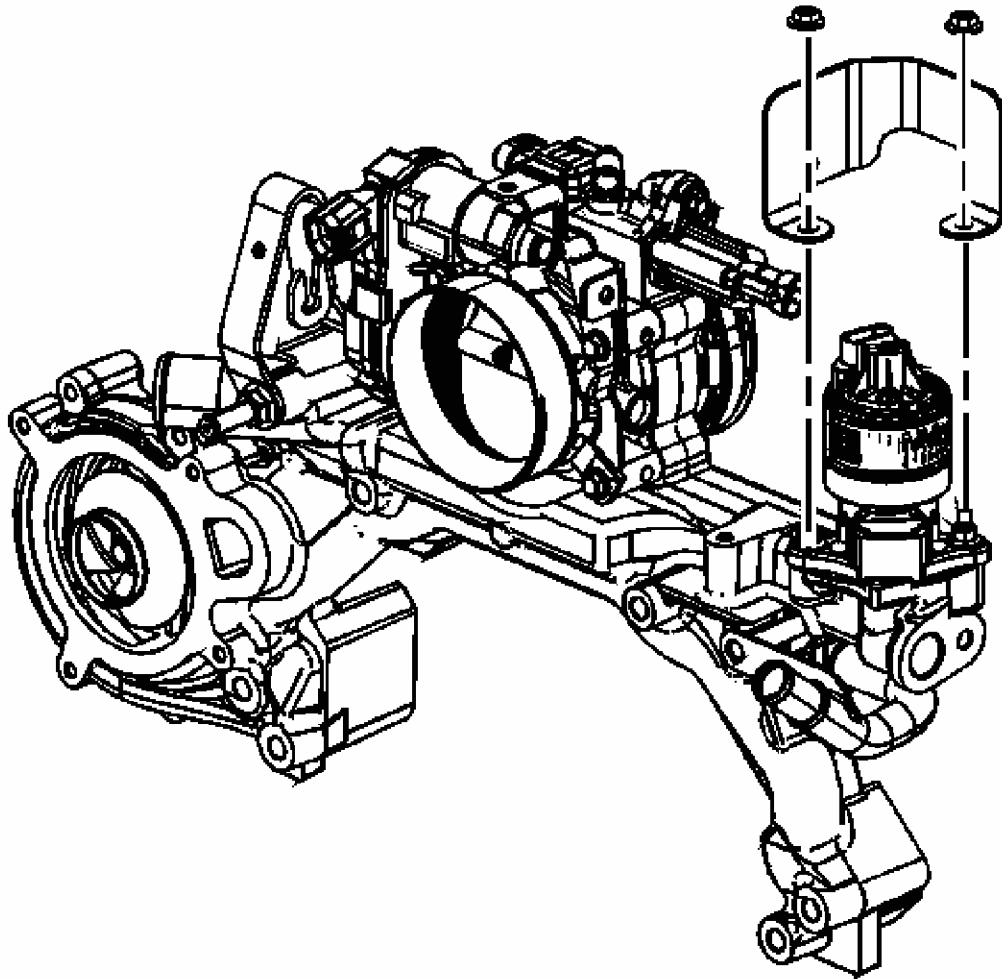




**Fig. 89: View Of EGR Valve Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

26. Install the NEW EGR valve gasket.
27. Install the EGR valve.
28. Install the EGR valve bolts.

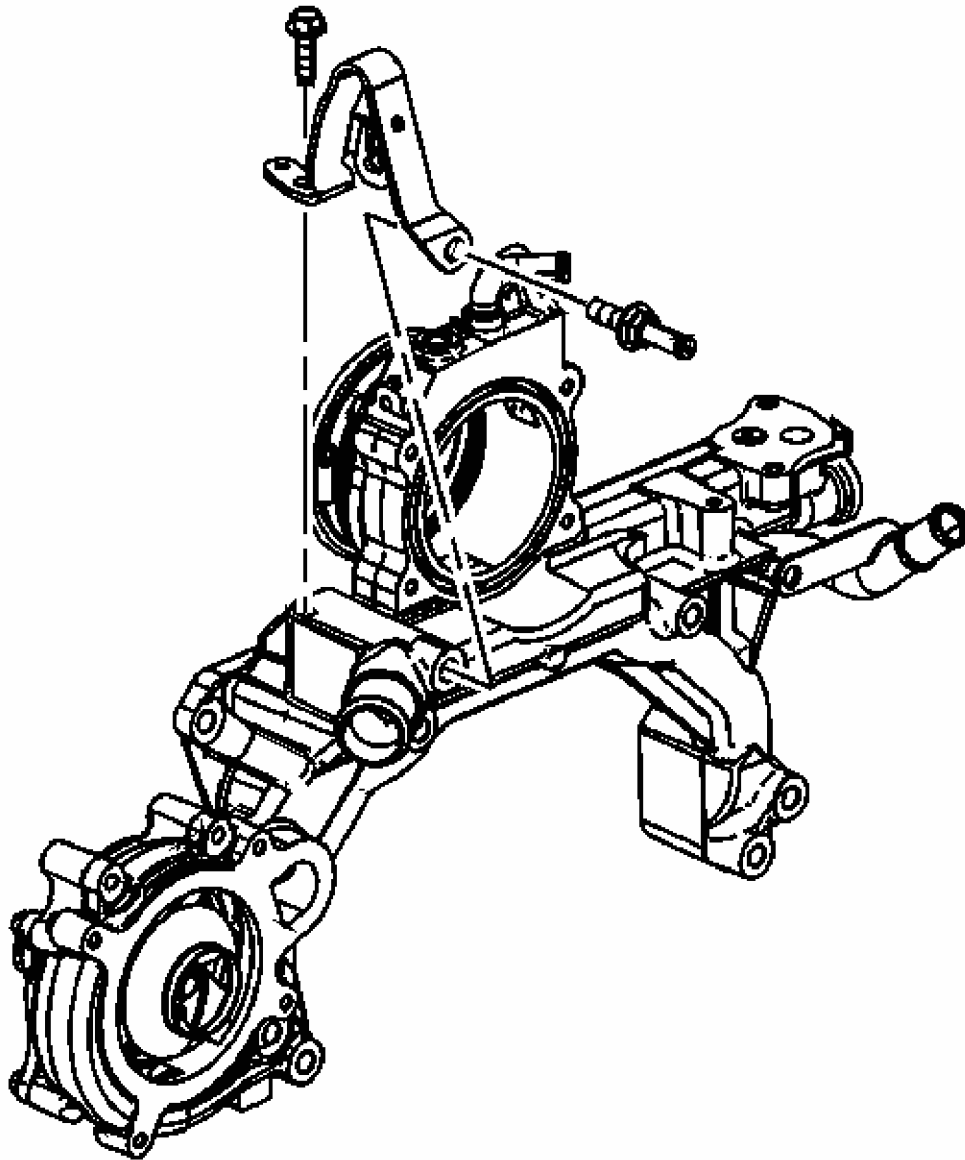
**Tighten:** Tighten the bolts to 25 N.m (18 lb ft).



**Fig. 90: Identifying EGR Bracket Shield Nuts**  
**Courtesy of GENERAL MOTORS CORP.**

29. Install the EGR valve shield.
30. Instal the EGR valve shield nuts.

**Tighten:** Tighten the nuts to 10 N.m (89 lb in).



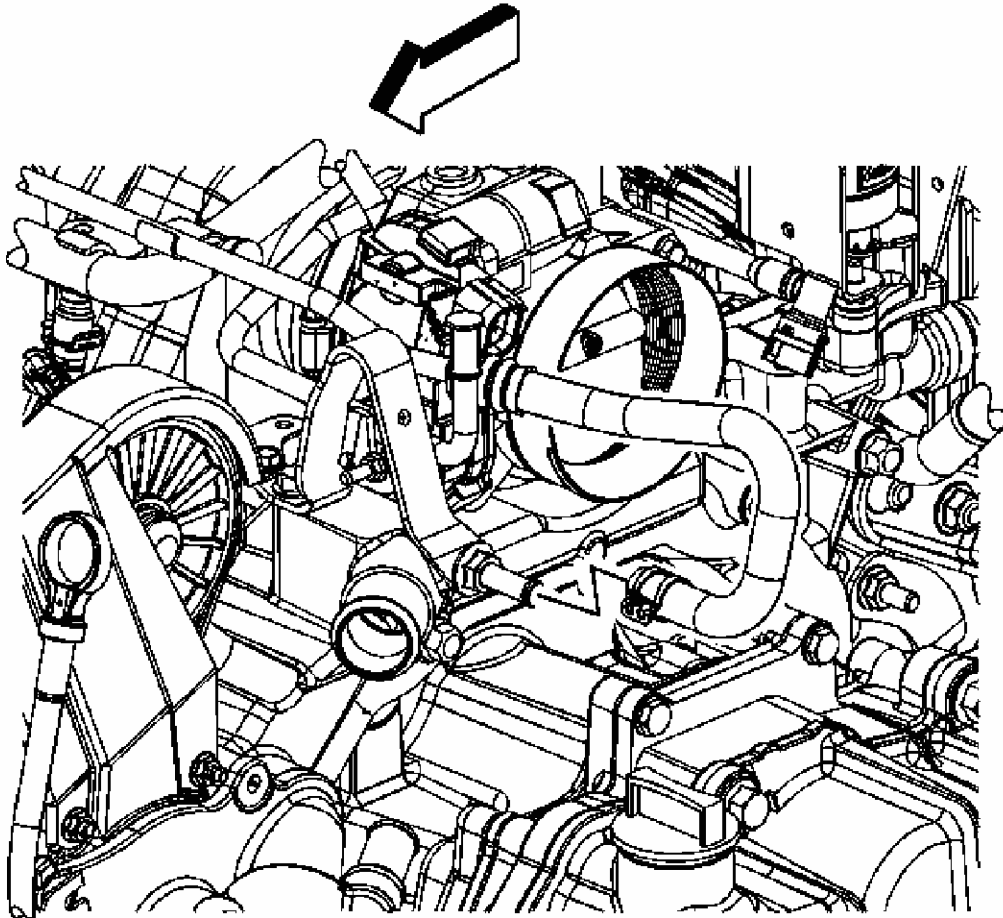
**Fig. 91: Identifying Engine Coolant Outlet Fitting**  
**Courtesy of GENERAL MOTORS CORP.**

31. Position the rear left lift bracket to the water pump housing.
32. Install the rear left lift bracket bolt.

**Tighten:** Tighten the bolt to 25 N.m (18 lb ft).

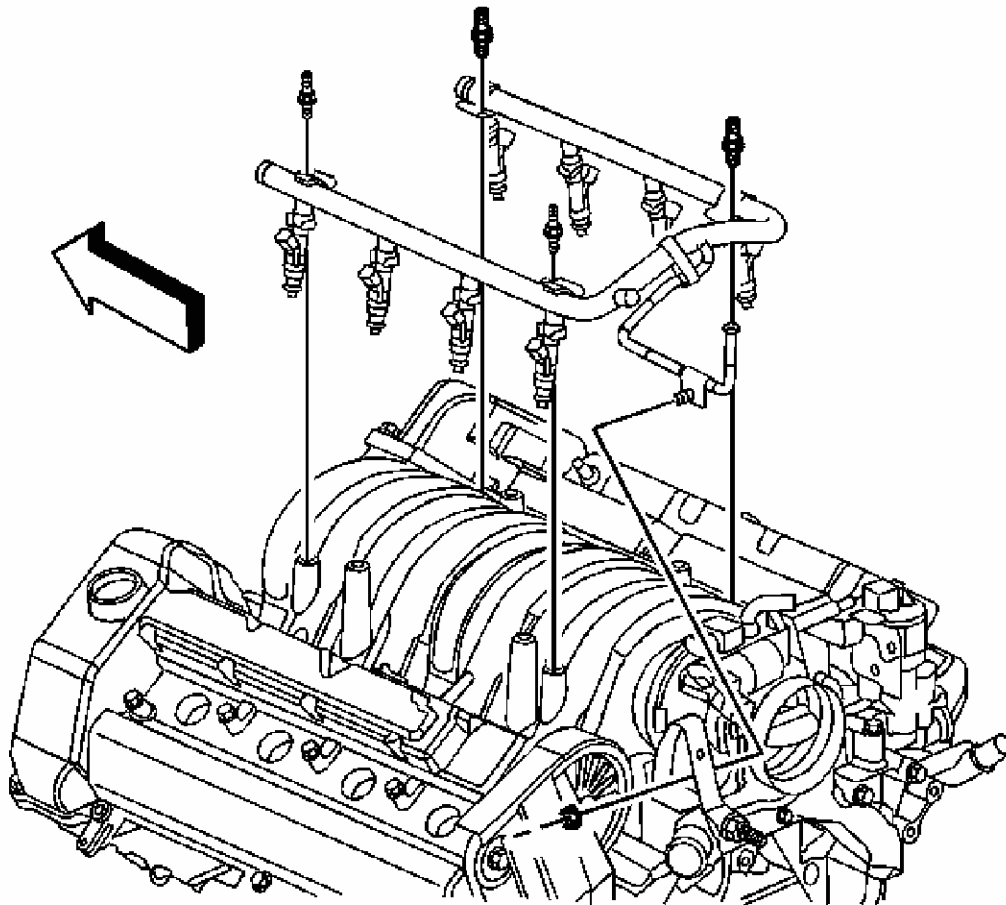
33. Install the engine coolant outlet fitting.

**Tighten:** Tighten the fitting to 47 N.m (35 lb ft).



**Fig. 92: View Of Surge Tank Inlet Hose/Pipe**  
**Courtesy of GENERAL MOTORS CORP.**

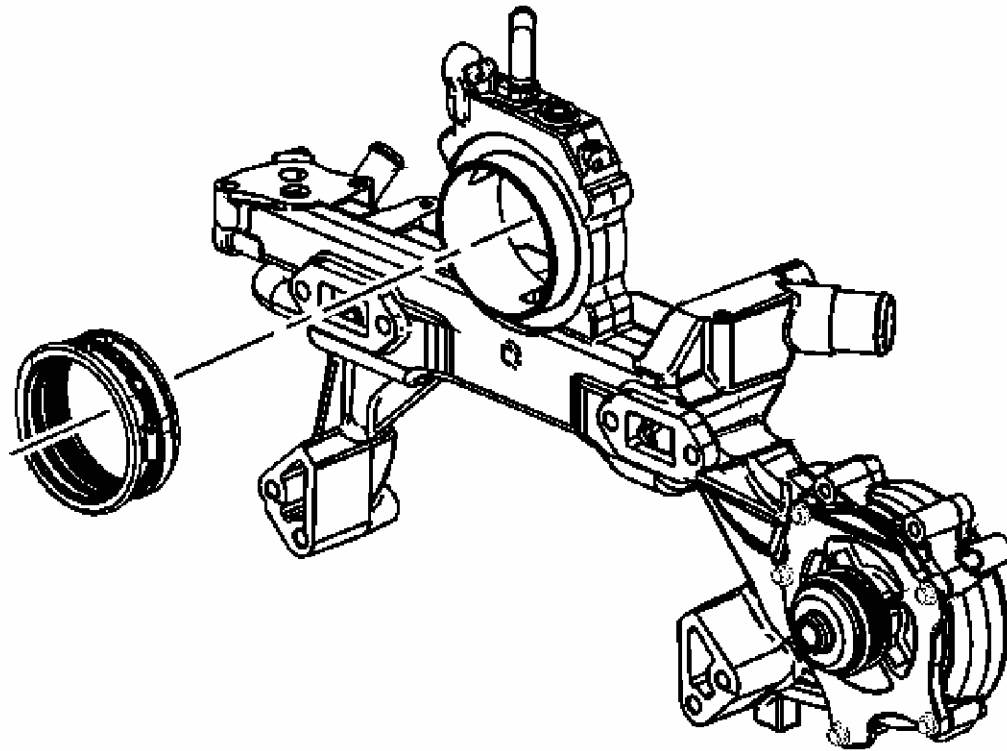
34. Install the surge tank inlet hose to the fitting.
35. Position the surge tank inlet hose clamp at the fitting.



**Fig. 93: View Of Fuel Rail, Bracket & Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

36. Instal the fuel rail bracket nut at the rear left lift bracket.

**Tighten:** Tighten the nut to 10 N.m (89 lb in).

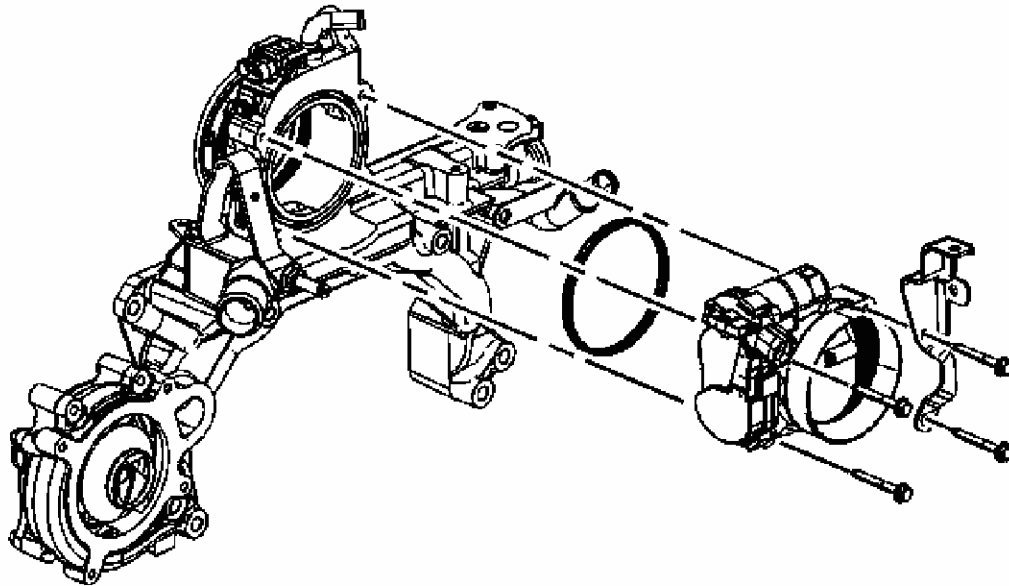


**Fig. 94: Identifying Throttle Body Plenum Duct**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** DO NOT use any type of sealant between the plenum and the water pump housing.

37. Install a NEW throttle body plenum duct.
38. Tighten the throttle body plenum duct clamp.

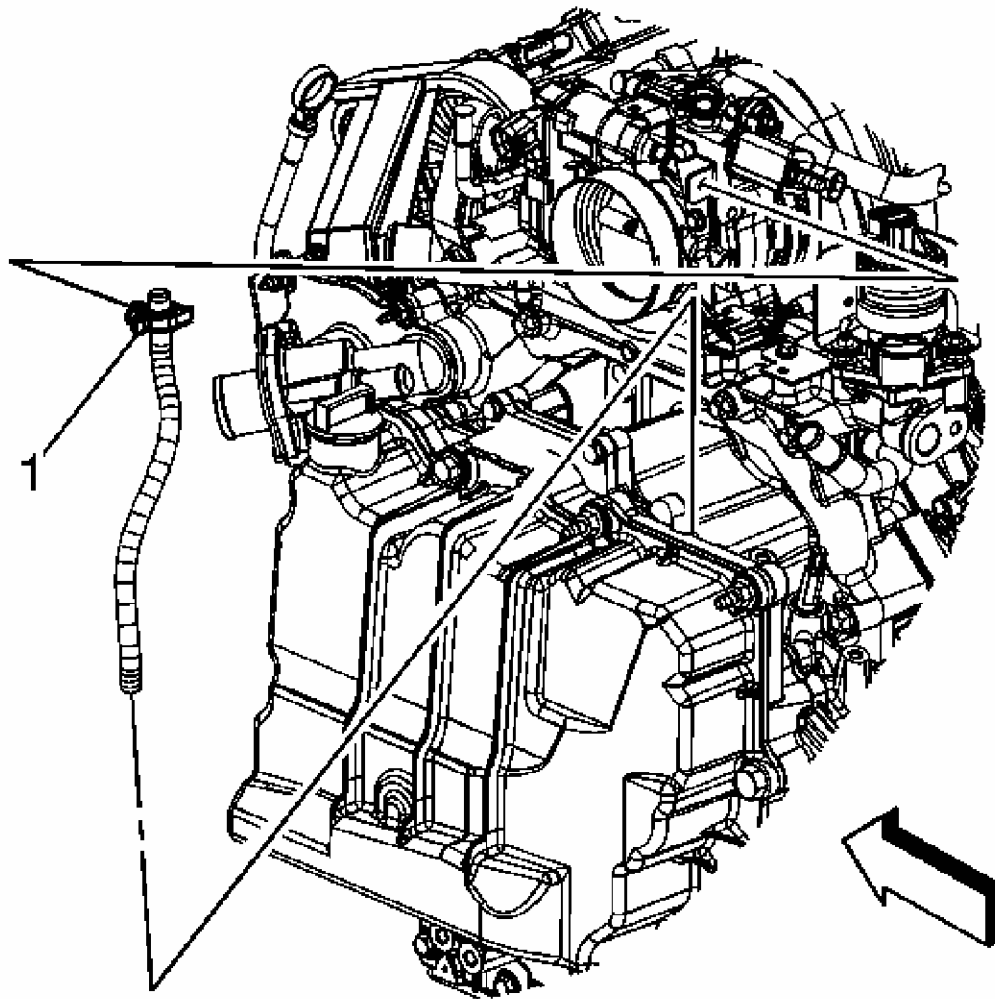
**Tighten:** Tighten the clamp to 2.25 N.m (20 lb in).



**Fig. 95: View Of Throttle Body Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

39. Install a NEW throttle body seal.
40. Install the throttle body.
41. Install the throttle body bracket.
42. Install the throttle body bolts.

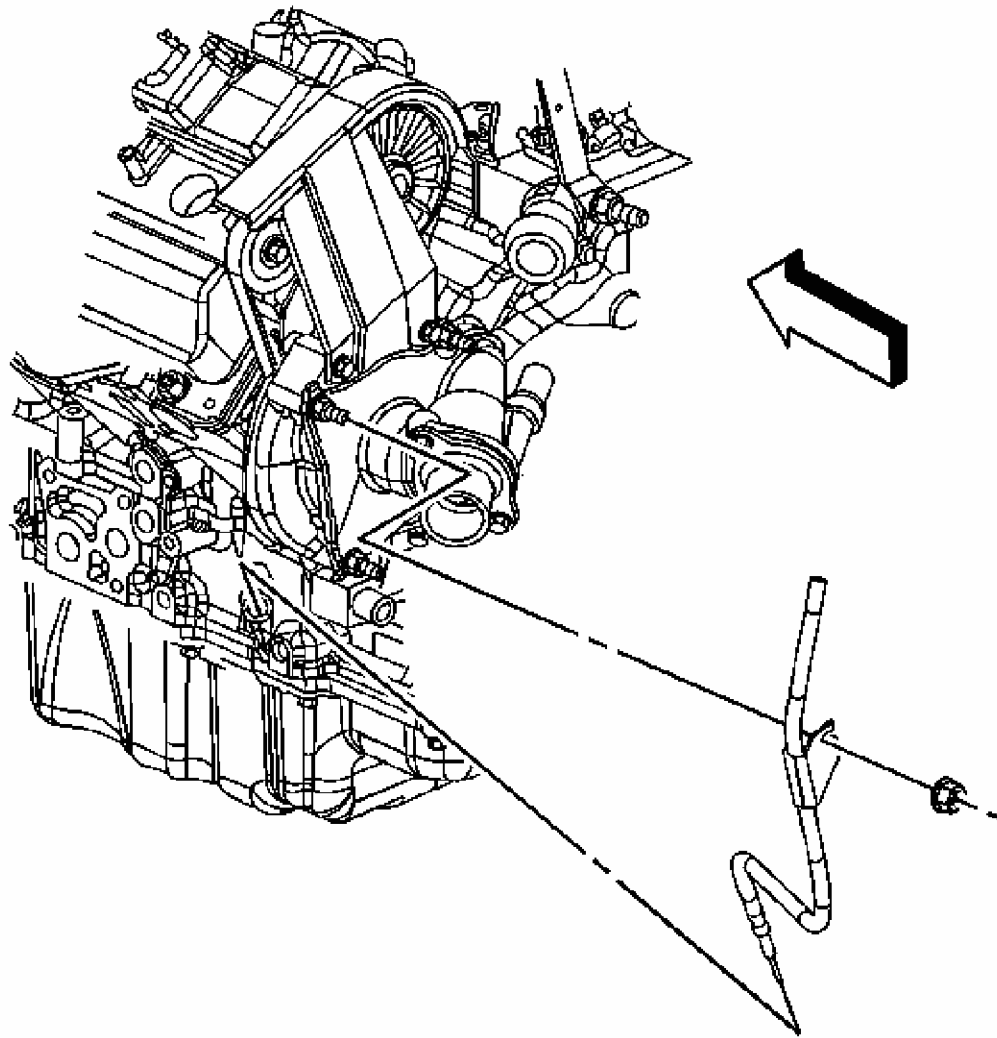
**Tighten:** Tighten the bolts to 10 N.m (89 lb in).



**Fig. 96: Identifying Transaxle Vent Hose Clip**  
**Courtesy of GENERAL MOTORS CORP.**

43. Install the transaxle vent hose clip (1) to the bracket.

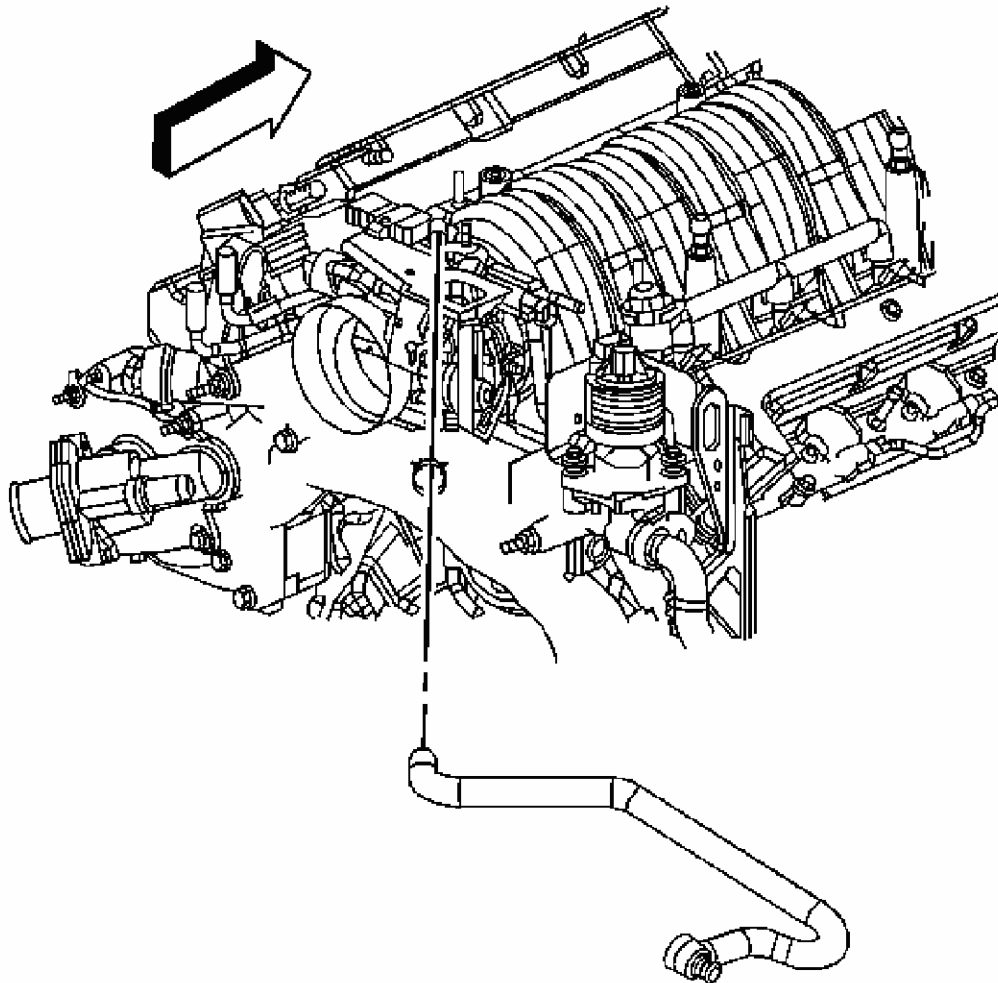




**Fig. 97: Identifying Oil Level Indicator Tube**  
**Courtesy of GENERAL MOTORS CORP.**

44. Position the oil level indicator tube.
45. Install the oil level indicator tube nut.

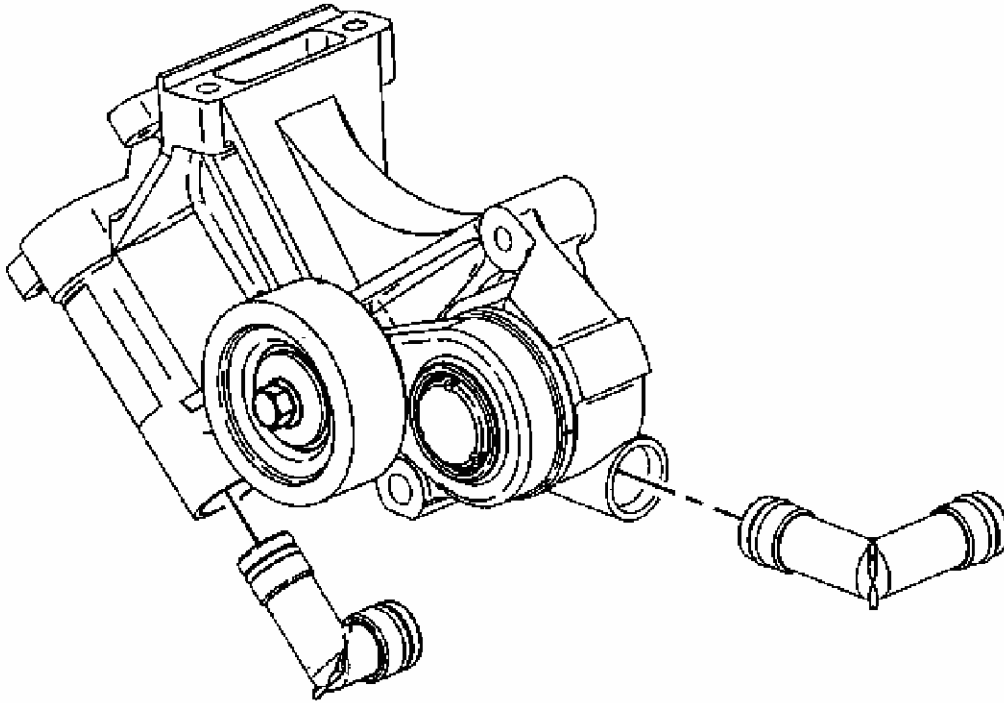
**Tighten:** Tighten the nut to 10 N.m (89 lb in).



**Fig. 98: View Of Coolant Crossover Pipe**  
**Courtesy of GENERAL MOTORS CORP.**

46. Install the brake booster vacuum hose to the water pump housing.
47. Position the brake booster vacuum hose clamp at the water pump housing.
48. Install the water pump drive belt. Refer to **Water Pump Belt Replacement (LD8)**.
49. Install the air cleaner. Refer to **Air Cleaner Assembly Replacement**.
50. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac-N-Fill)**.
51. Install the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement**.

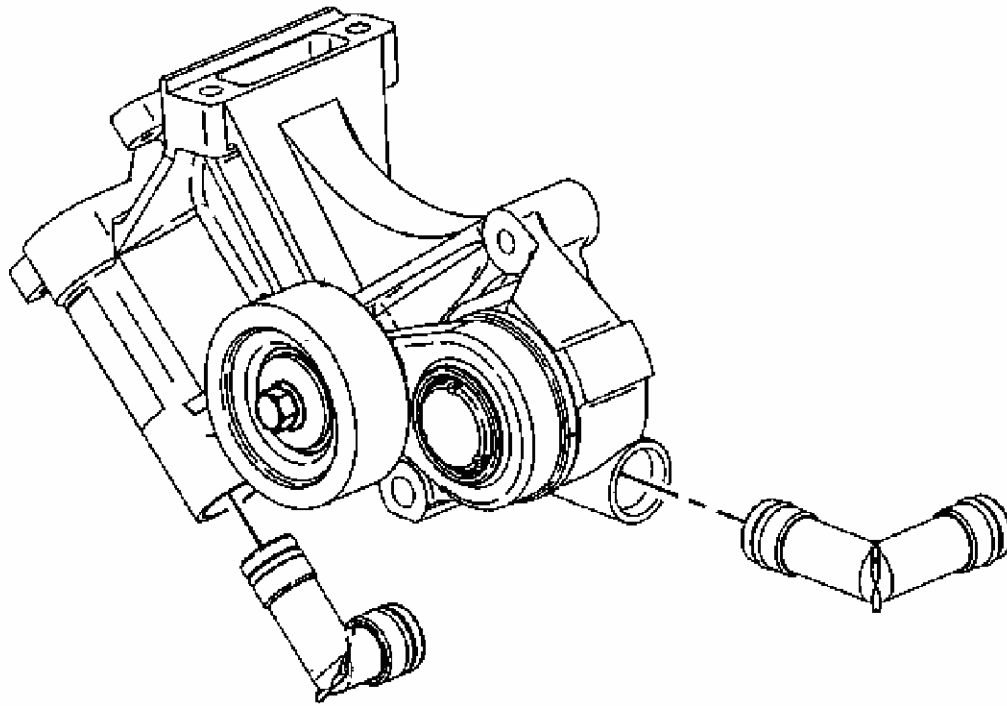
### Removal Procedure



**Fig. 99: View Of Drive Belt Tensioner**  
**Courtesy of GENERAL MOTORS CORP.**

1. Remove the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement** .
2. Remove the thermostat bypass upper and lower pipes.

### Installation Procedure

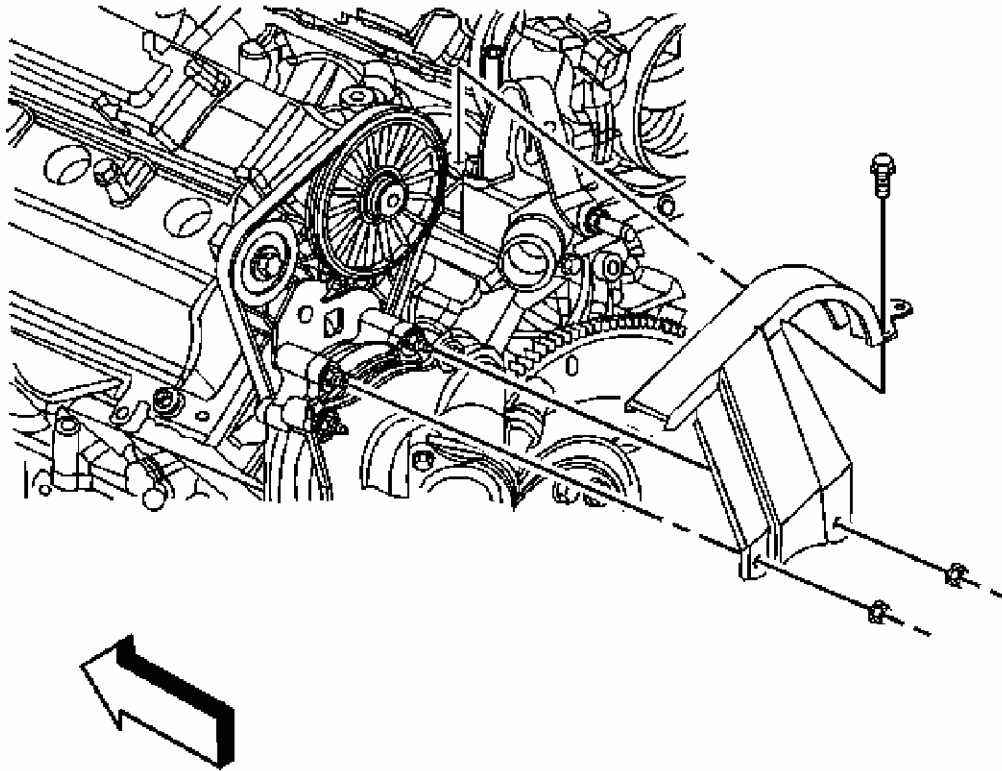


**Fig. 100: View Of Drive Belt Tensioner**  
**Courtesy of GENERAL MOTORS CORP.**

1. Lubricate the thermostat bypass upper and lower pipe seals with engine coolant and install the upper and lower pipes to the tensioner.
2. Install the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement** .

#### **WATER PUMP DRIVE BELT TENSIONER SHIELD REPLACEMENT (LD8)**

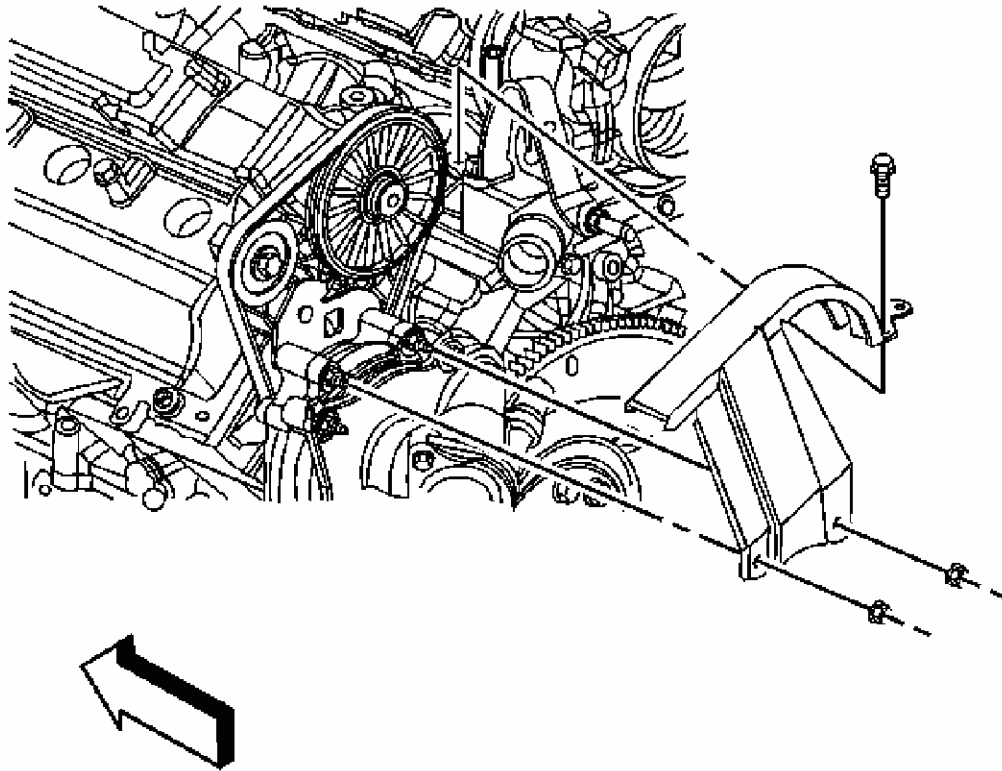
##### **Removal Procedure**



**Fig. 101: View Of Water Pump Drive Belt Tensioner Shield**  
**Courtesy of GENERAL MOTORS CORP.**

1. Remove the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement** .
2. Remove the water pump drive belt tensioner shield bolt/nuts.
3. Remove the water pump drive belt tensioner shield.

**Installation Procedure**



**Fig. 102: View Of Water Pump Drive Belt Tensioner Shield**  
**Courtesy of GENERAL MOTORS CORP.**

1. Install the water pump drive belt tensioner shield onto the studs.

**NOTE:** Refer to Fastener Notice .

2. Install the water pump drive belt tensioner shield bolt/nuts.

**Tighten:** Tighten the bolt/nuts to 10 N.m (89 lb in).

3. Install the fuel injector sight shield. Refer to Fuel Injector Sight Shield Replacement .

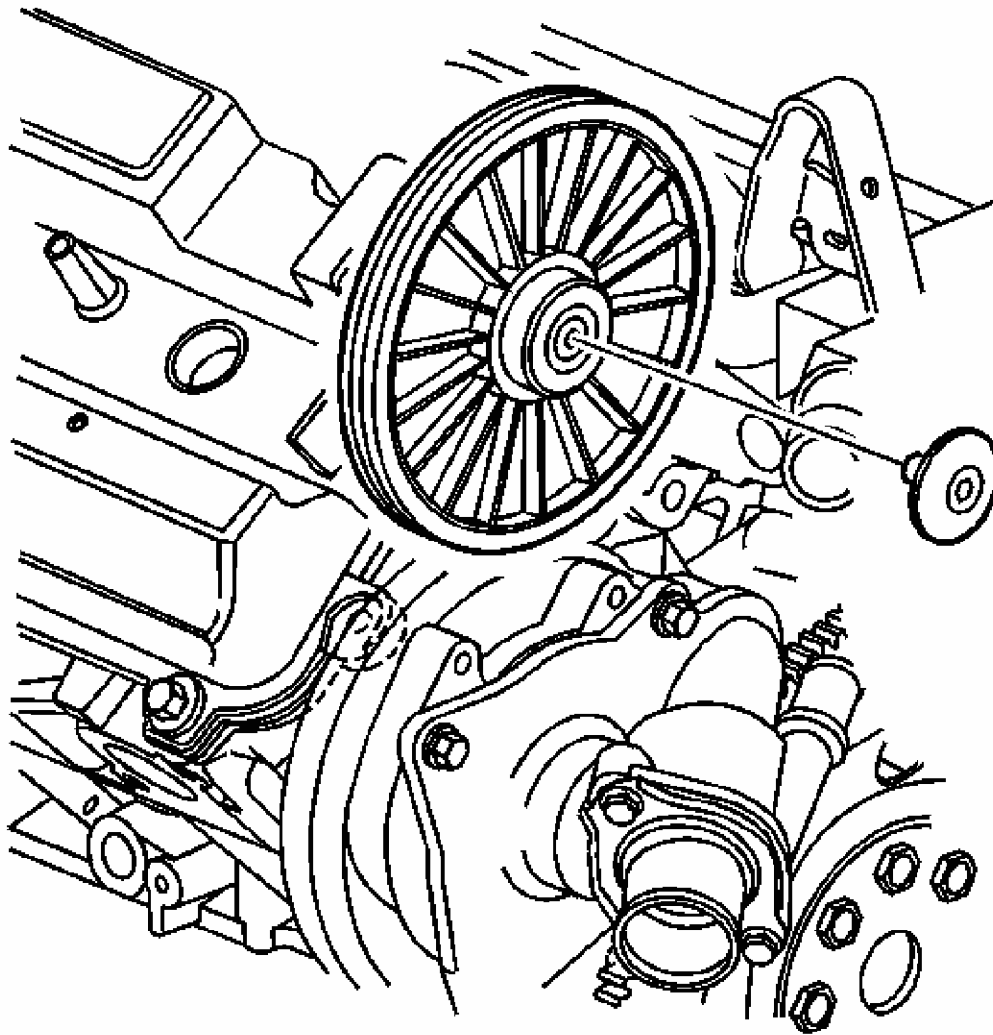
#### **WATER PUMP PULLEY REPLACEMENT (LD8)**

##### **Tools Required**

- **J 38823** Water Pump Pulley Installer
- **J 38825** Power Steering and Water Pump Pulley Remover

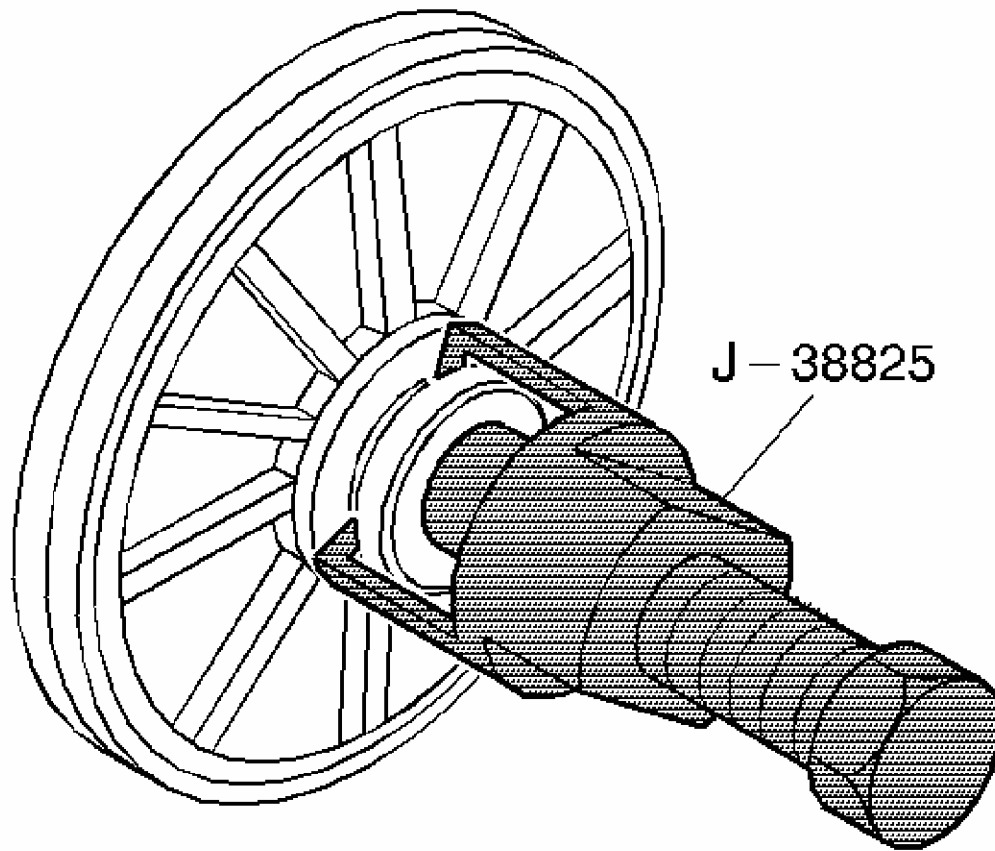
- **J 39946** Crankshaft Socket - 4.0L and 4.6L

**Removal Procedure**



**Fig. 103: Identifying Intake Camshaft End Cap**  
**Courtesy of GENERAL MOTORS CORP.**

1. Remove the water pump drive belt tensioner shield. Refer to **Fuel Injector Sight Shield Replacement** .
2. Align the crankshaft to top dead center (TDC) using the **J 39946** .
3. Remove the end cap from the intake camshaft.



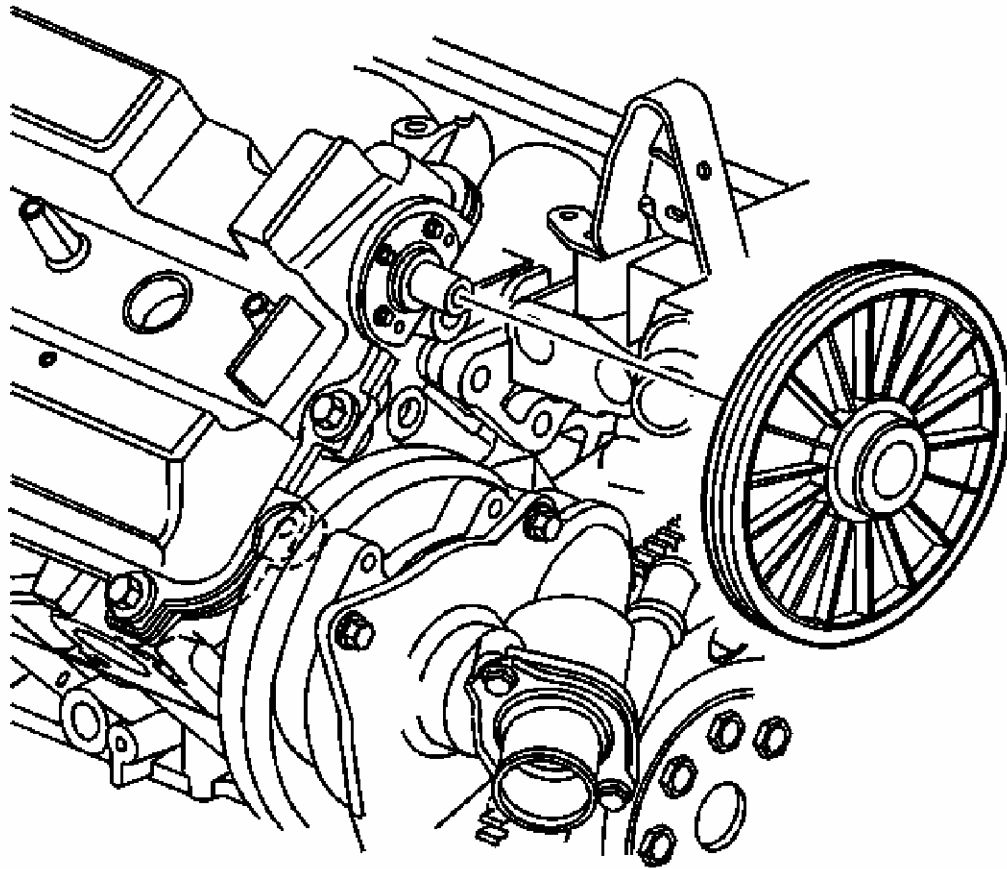
**Fig. 104: View of J 38825**

**Courtesy of GENERAL MOTORS CORP.**

4. Remove the water pump drive pulley from the intake camshaft using the **J 38825** .

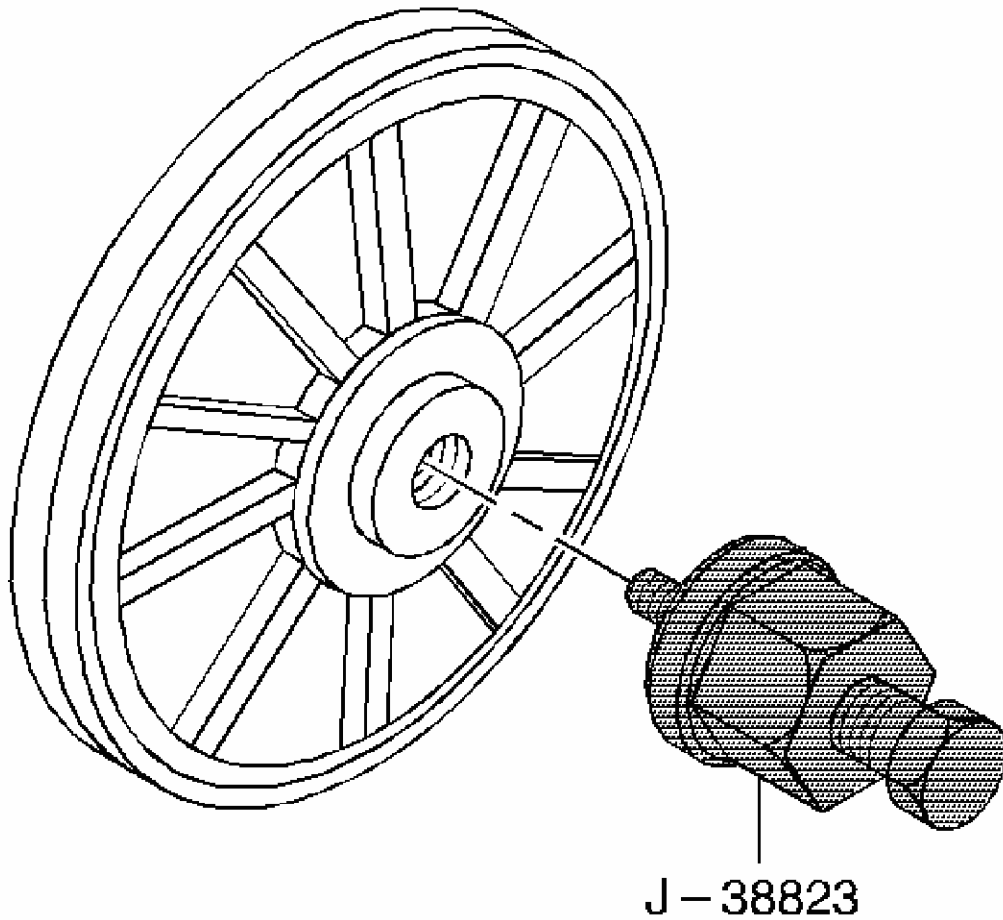
**Installation Procedure**





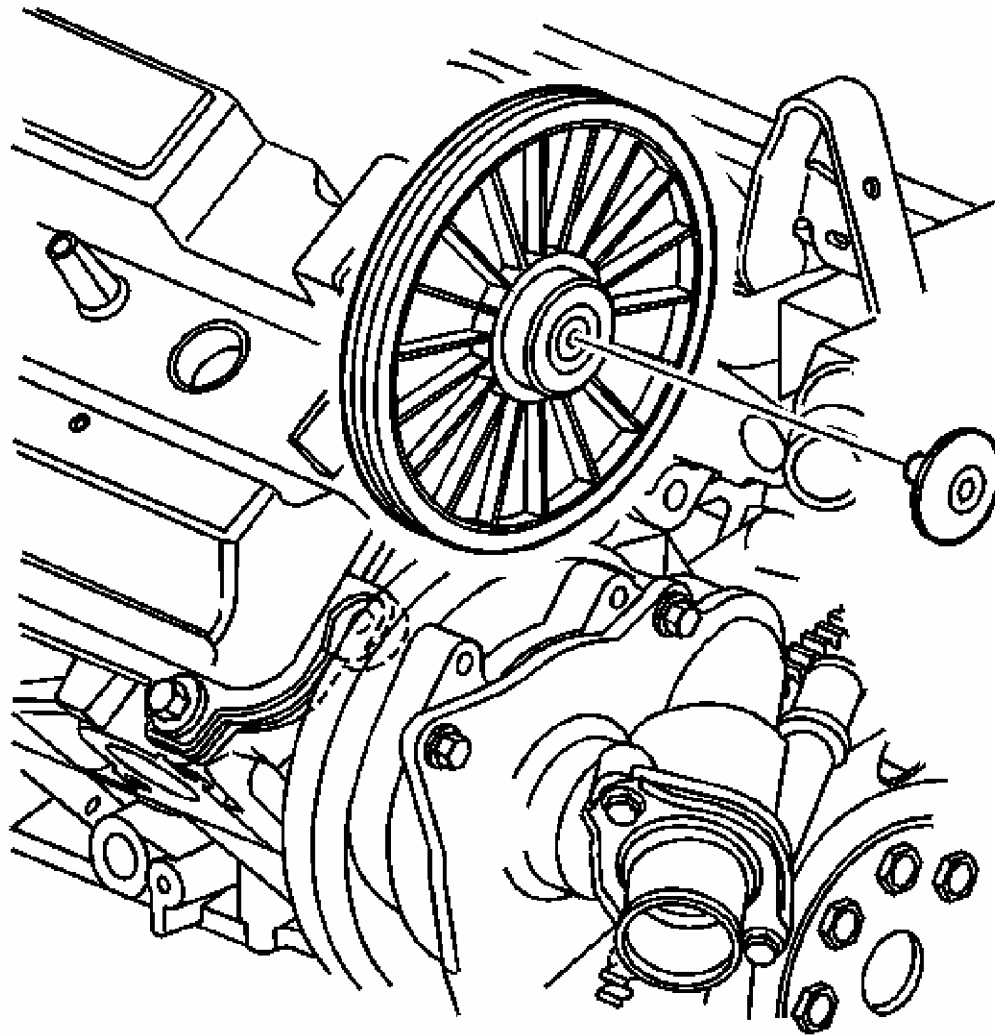
**Fig. 105: View of Water Pump Drive Pulley**  
**Courtesy of GENERAL MOTORS CORP.**

1. Place the water pump drive pulley in position on the intake camshaft.



**Fig. 106: View of J 38823 Installing Water Pump Pulley**  
**Courtesy of GENERAL MOTORS CORP.**

2. Install the water pump pulley onto the intake camshaft using the **J 38823** . During installation, the tool will bottom out on the camshaft at the proper depth.



**Fig. 107: Identifying Intake Camshaft End Cap**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to Fastener Notice .

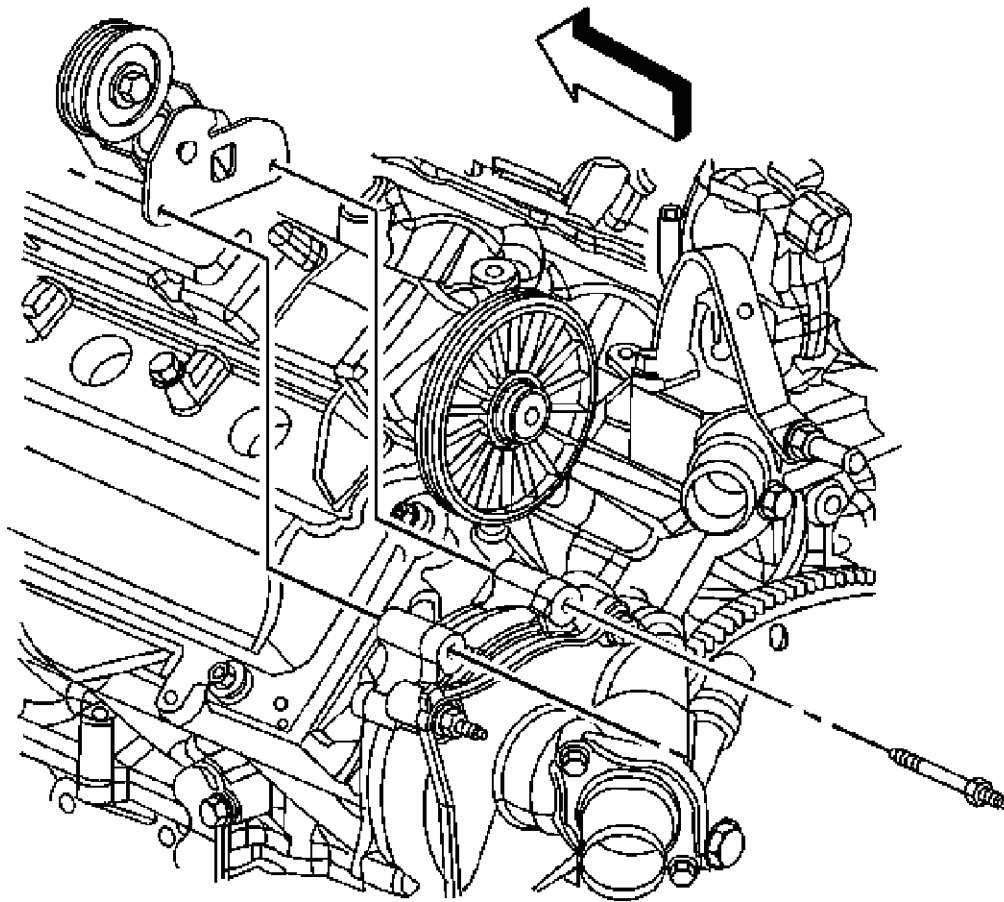
3. Install the camshaft end cap.

**Tighten:** Tighten the cap to 2 N.m (18 lb in).

4. Install the water pump drive belt tensioner shield. Refer to Fuel Injector Sight Shield Replacement .

## **WATER PUMP DRIVE BELT TENSIONER REPLACEMENT (LD8)**

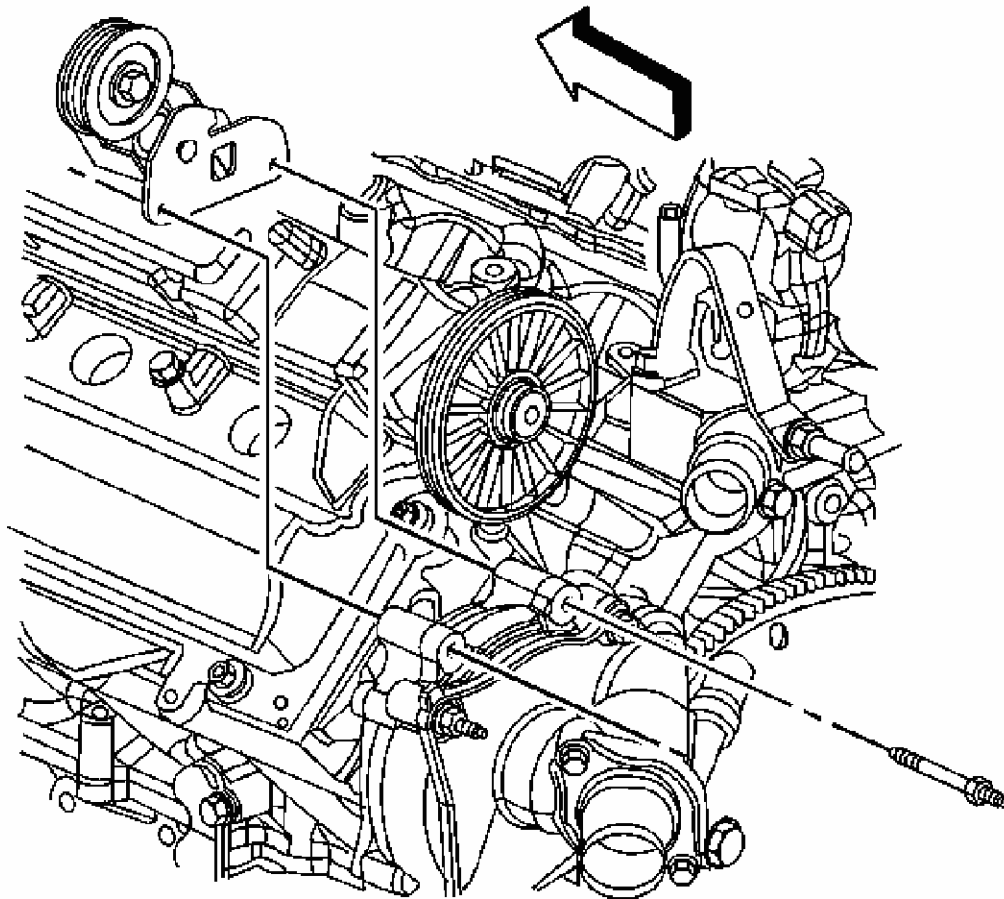
### **Removal Procedure**



**Fig. 108: View Of Water Pump Drive Belt Tensioner**  
**Courtesy of GENERAL MOTORS CORP.**

1. Remove the water pump drive belt. Refer to **Water Pump Belt Replacement (LD8)**.
2. Remove the water pump drive belt tensioner studs.
3. Remove the water pump drive belt tensioner.

### **Installation Procedure**



**Fig. 109: View Of Water Pump Drive Belt Tensioner**  
**Courtesy of GENERAL MOTORS CORP.**

1. Position the water pump drive belt tensioner to the water pump housing.

**NOTE:** Refer to Fastener Notice .

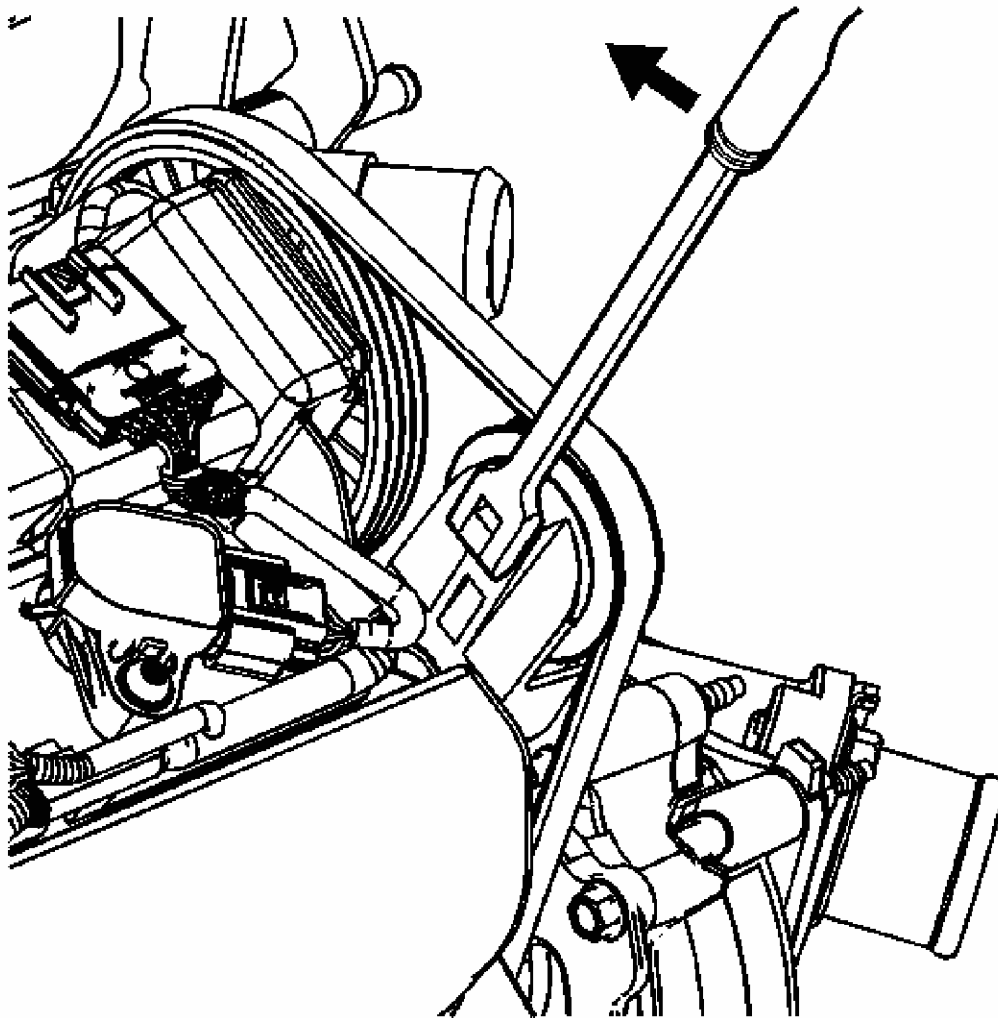
2. Install the water pump drive belt tensioner studs.

**Tighten:** Tighten the studs to 10 N.m (89 lb in).

3. Install the water pump drive belt. Refer to Water Pump Belt Replacement (LD8).

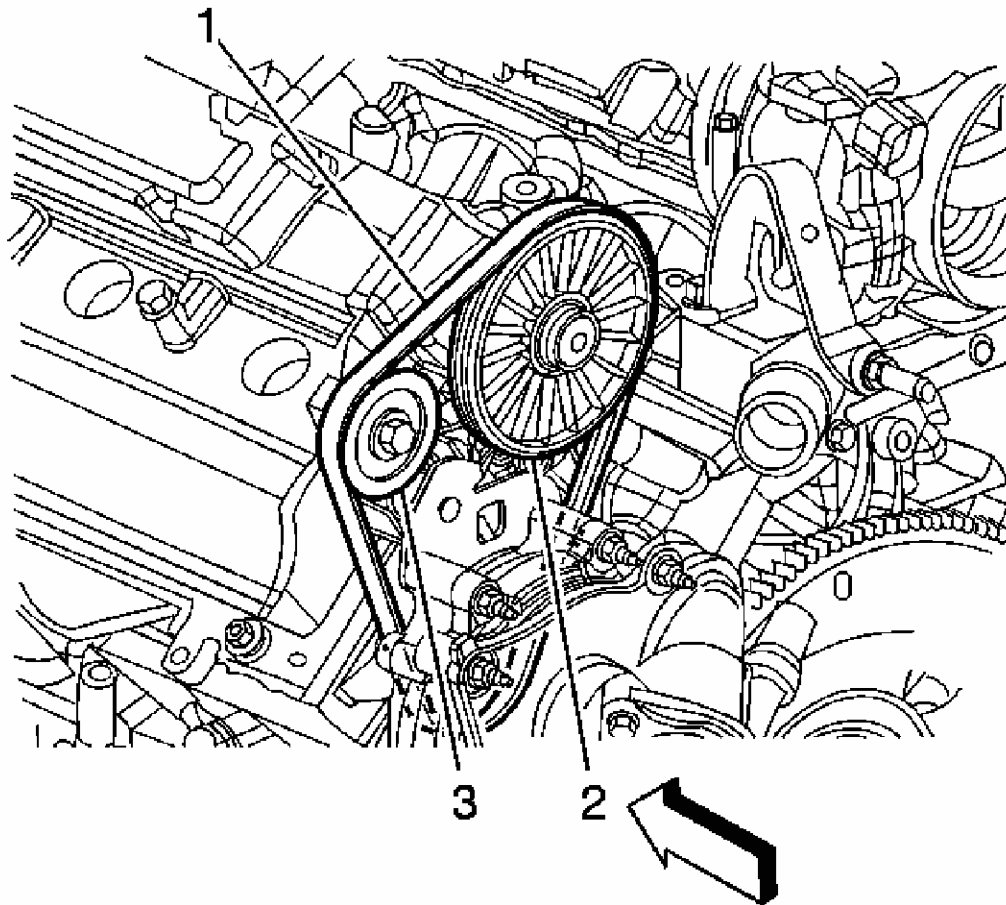
## **WATER PUMP BELT REPLACEMENT (LD8)**

### **Removal Procedure**



**Fig. 110: Rotating Water Pump Drive Belt Tensioner**  
**Courtesy of GENERAL MOTORS CORP.**

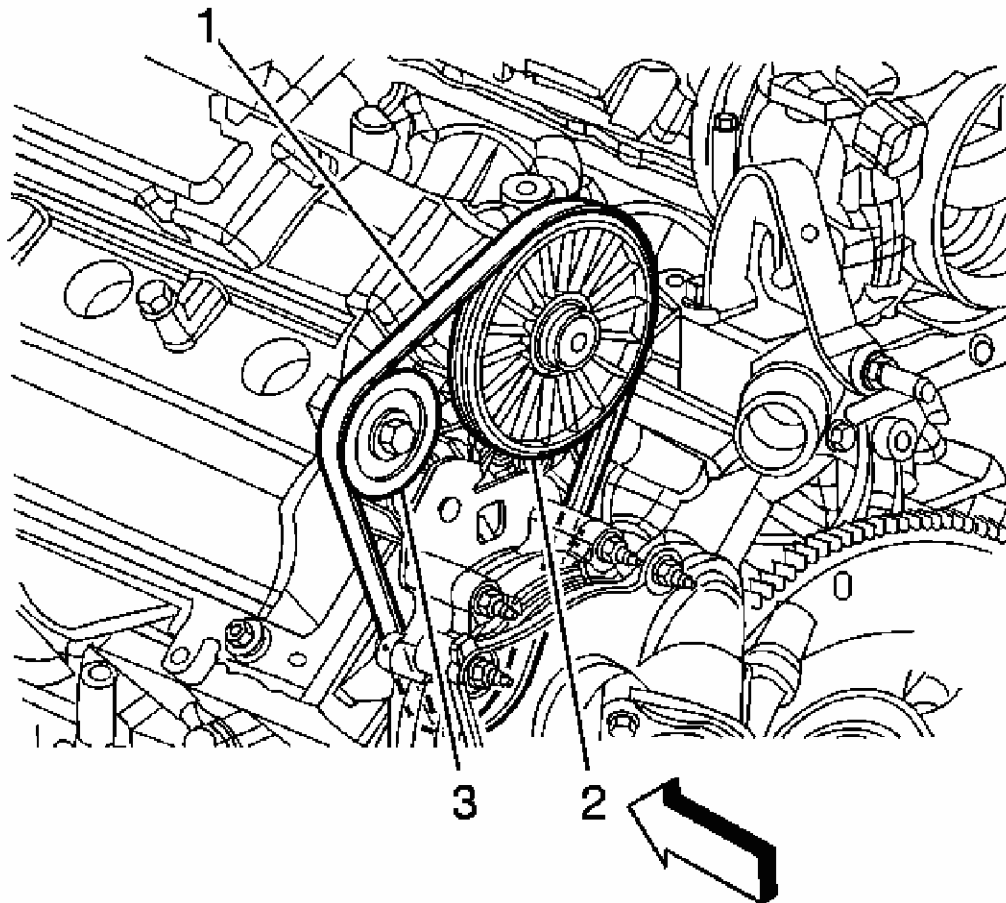
1. Remove the water pump drive belt tensioner shield. Refer to **Water Pump Drive Belt Tensioner Shield Replacement (LD8)**.
2. Insert a breaker bar into the drive belt tensioner and rotate the tensioner.



**Fig. 111: Removing/Installing Water Pump Drive Belt**  
**Courtesy of GENERAL MOTORS CORP.**

3. Remove the water pump drive belt (1) by sliding the belt off of the drive pulley (3) and water pump pulley.

**Installation Procedure**



**Fig. 112: Removing/Installing Water Pump Drive Belt**  
**Courtesy of GENERAL MOTORS CORP.**

1. Route the water pump drive belt (1) around the water pump pulley and the water pump drive belt tensioner (3).
2. Compress the drive belt tensioner. Route the drive belt around the drive pulley (2).
3. Check the drive belt for proper seating in all the pulley grooves.
4. Install the water pump drive belt tensioner shield. Refer to **Water Pump Drive Belt Tensioner Shield Replacement (LD8)**.

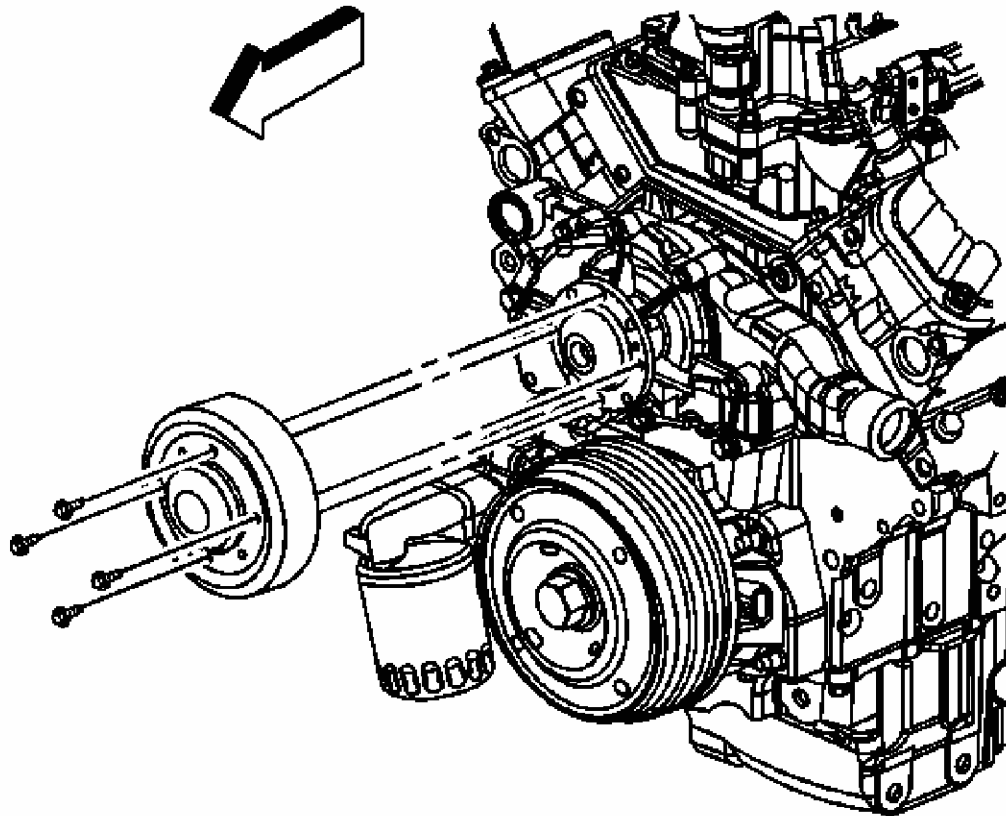
#### **WATER PUMP REPLACEMENT (L26)**

##### **Tools Require**

**J 45059** Angle Meter

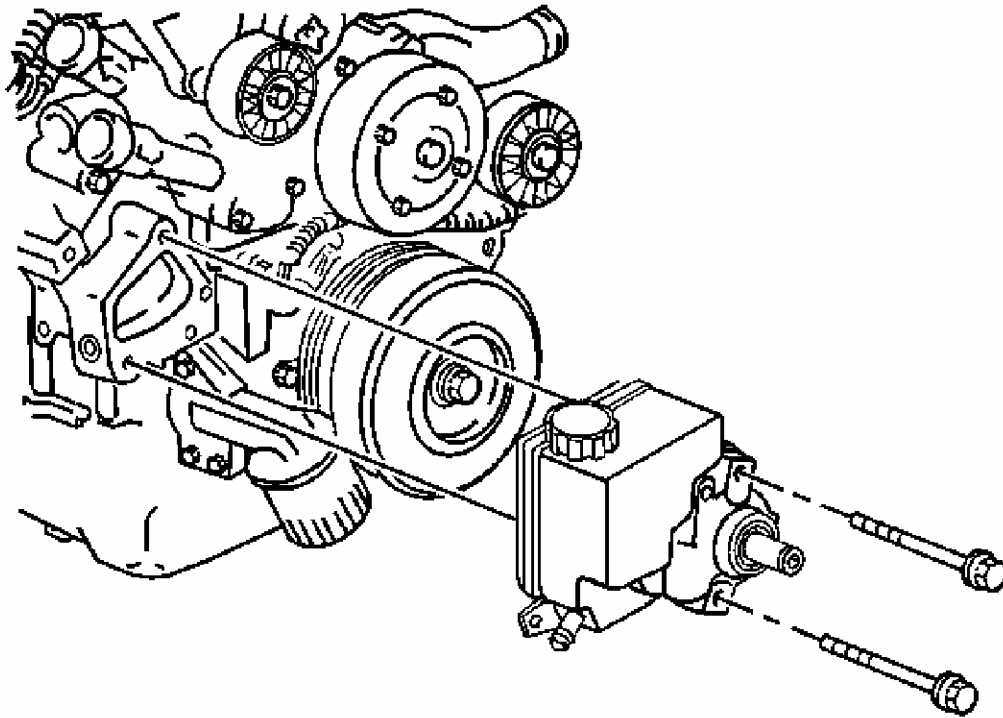


**Removal Procedure**



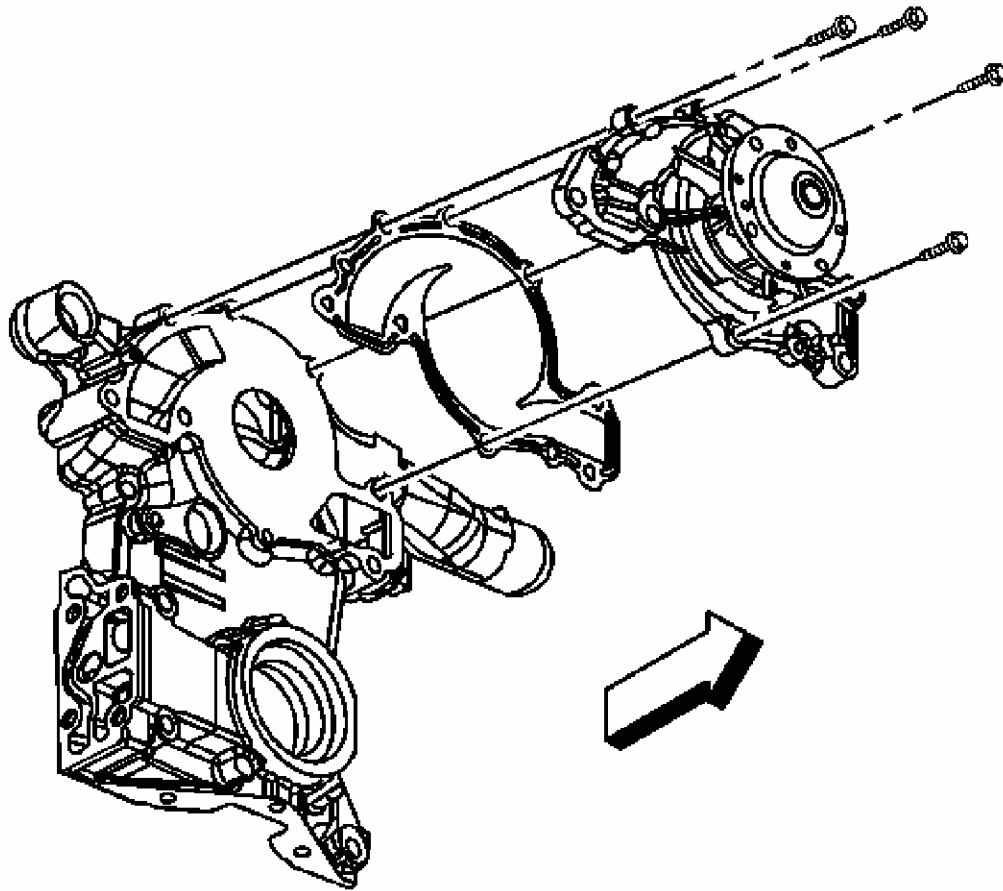
**Fig. 113: Identifying Water Pump Pulley & Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac-N-Fill)**.
2. Loosen the water pump pulley bolts.
3. Remove the drive belt. Refer to **Drive Belt Replacement** .
4. Remove the water pump pulley bolts.
5. Remove the water pump pulley.



**Fig. 114: View Of Power Steering Pump And Mounting Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

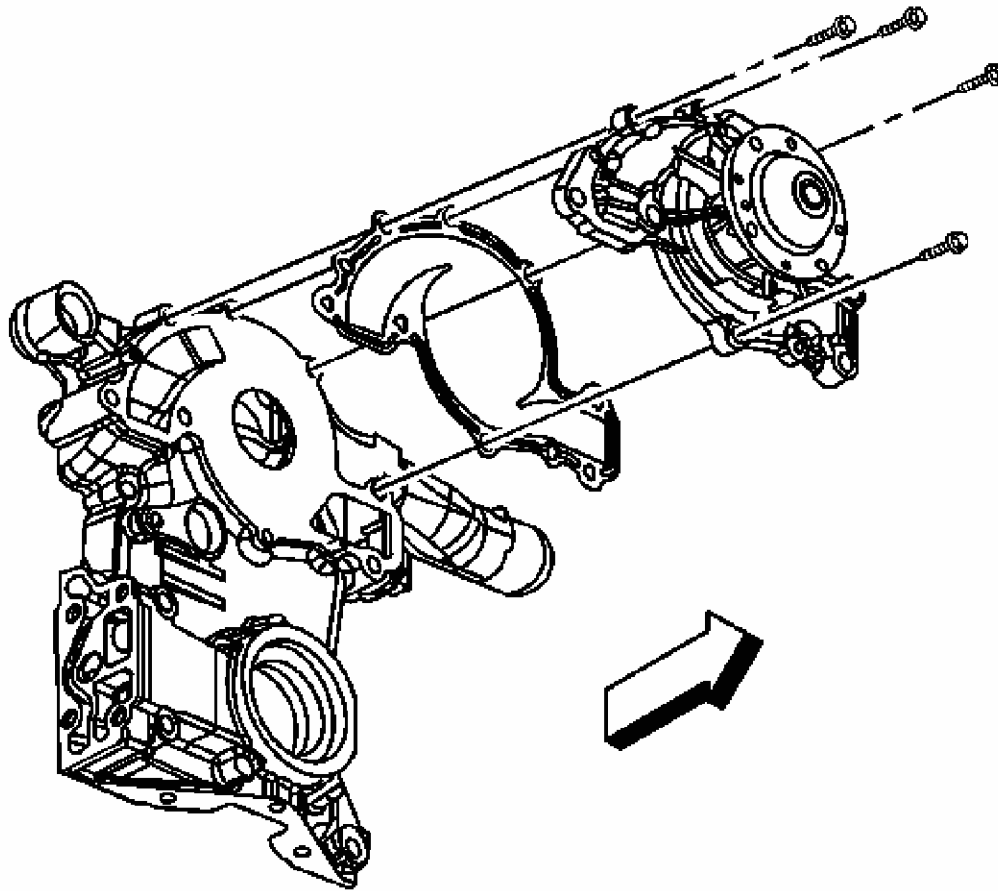
6. Remove the power steering pump bolts and reposition the pump.



**Fig. 115: Removing/Installing Water Pump Assembly**  
**Courtesy of GENERAL MOTORS CORP.**

7. Remove the water pump bolts.
8. Remove the water pump.
9. Remove the water pump gasket.
10. Clean and inspect the water pump mating surfaces.

**Installation Procedure**



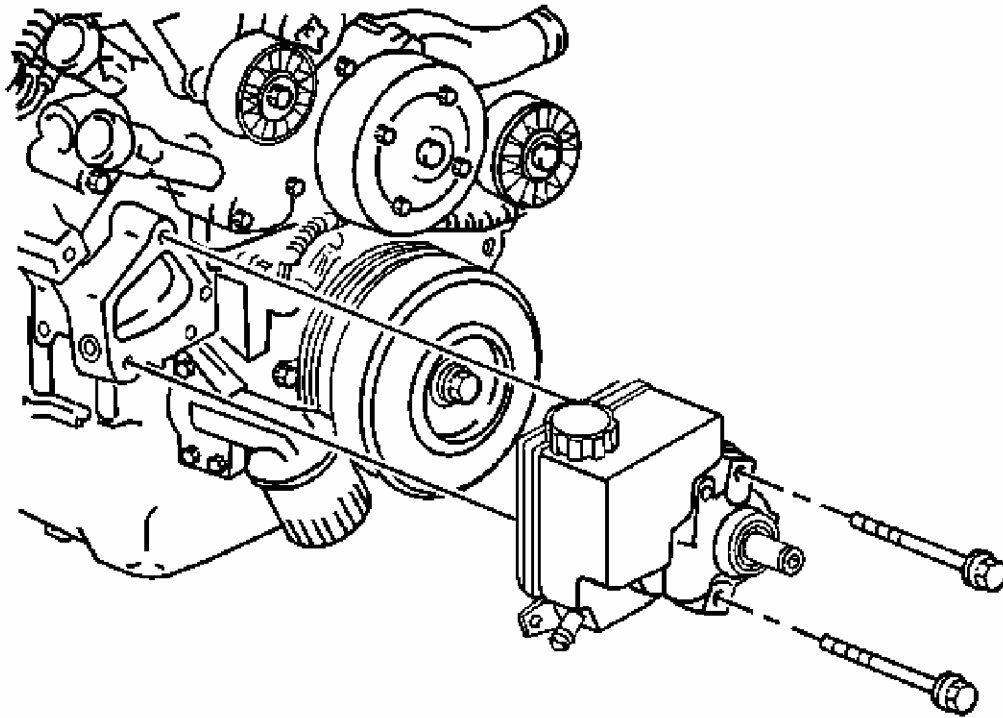
**Fig. 116: Removing/Installing Water Pump Assembly**  
**Courtesy of GENERAL MOTORS CORP.**

1. Install the water pump gasket.
2. Install the water pump.

**NOTE:** Refer to Fastener Notice .

3. Install the water pump bolts.

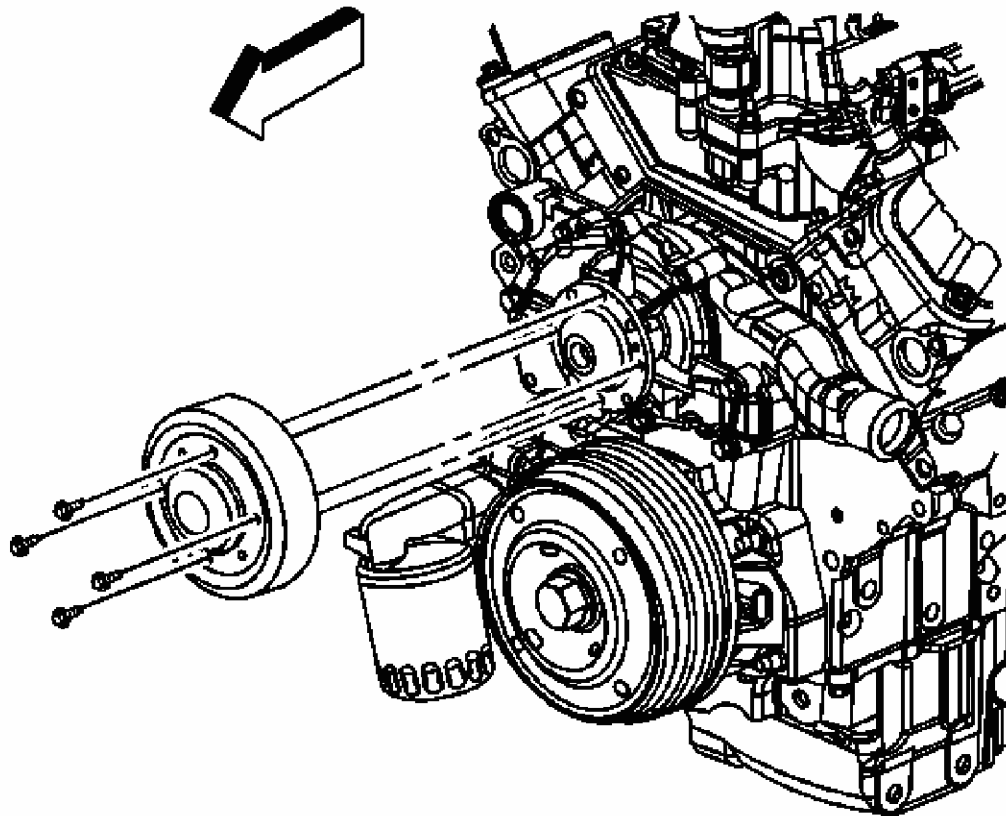
**Tighten:** Tighten the bolts to 15 N.m (11 lb ft) plus an additional 80 degrees using **J 45059** .



**Fig. 117: View Of Power Steering Pump And Mounting Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

4. Position the power steering pump and install the bolts.

**Tighten:** Tighten the bolts to 34 N.m (25 lb ft).



**Fig. 118: Identifying Water Pump Pulley & Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

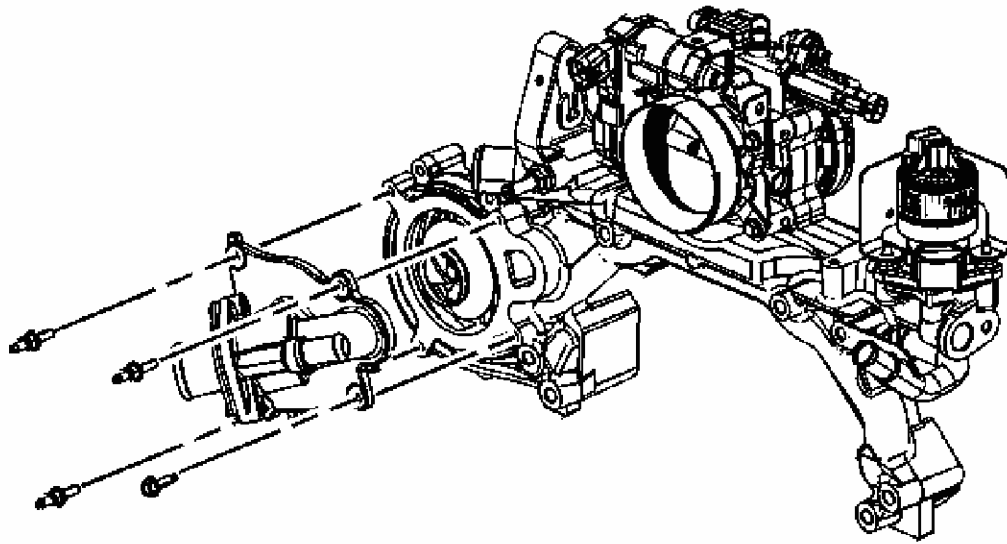
5. Install the water pump pulley.
6. Install the water pump pulley bolts until snug.
7. Install the drive belt. Refer to **Drive Belt Replacement** .
8. Tighten the water pump pulley bolts.

**Tighten:** Tighten the bolts to 13 N.m (115 lb in).

9. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac-N-Fill)**.

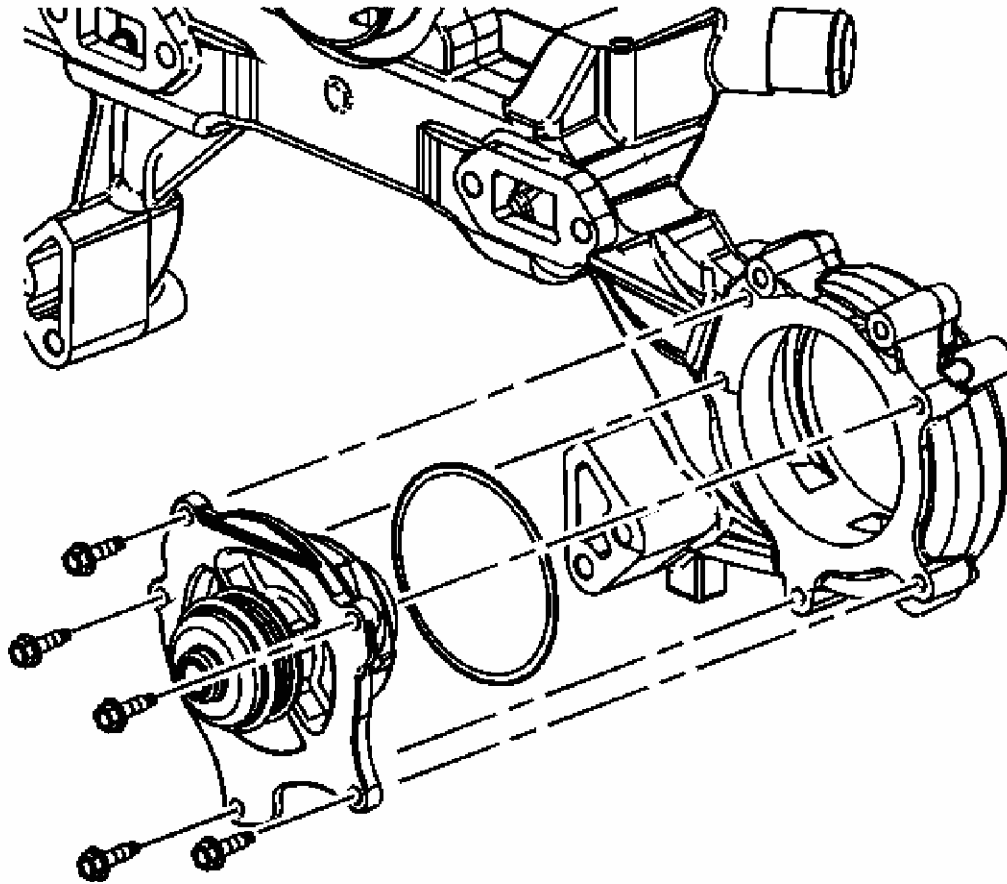
## **WATER PUMP REPLACEMENT (LD8)**

### **Removal Procedure**



**Fig. 119: Identifying Water Pump Cover Bolts/Studs**  
**Courtesy of GENERAL MOTORS CORP.**

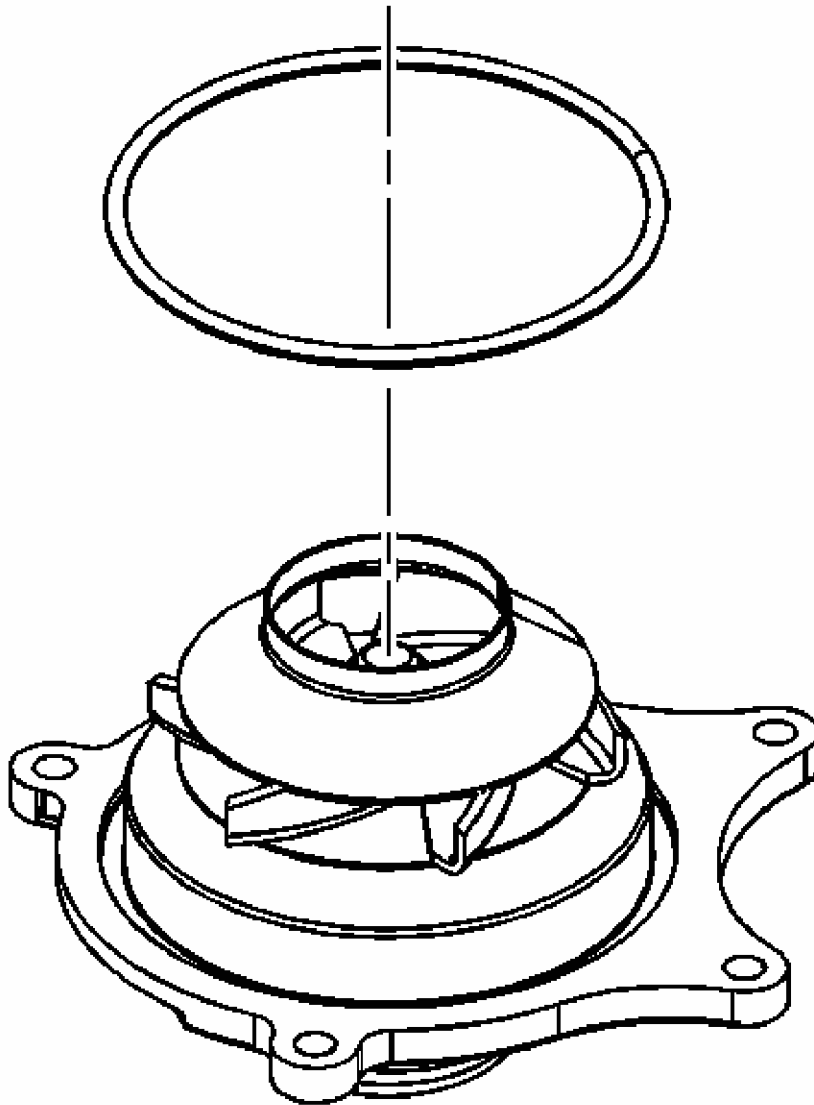
1. Remove the water pump housing. Refer to **Engine Coolant Crossover Pipe Replacement (LD8)**.
2. Remove the water pump cover bolt/studs.
3. Remove the water pump cover.



**Fig. 120: Identifying Water Pump Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

4. Remove the water pump bolts.
5. Remove the water pump.

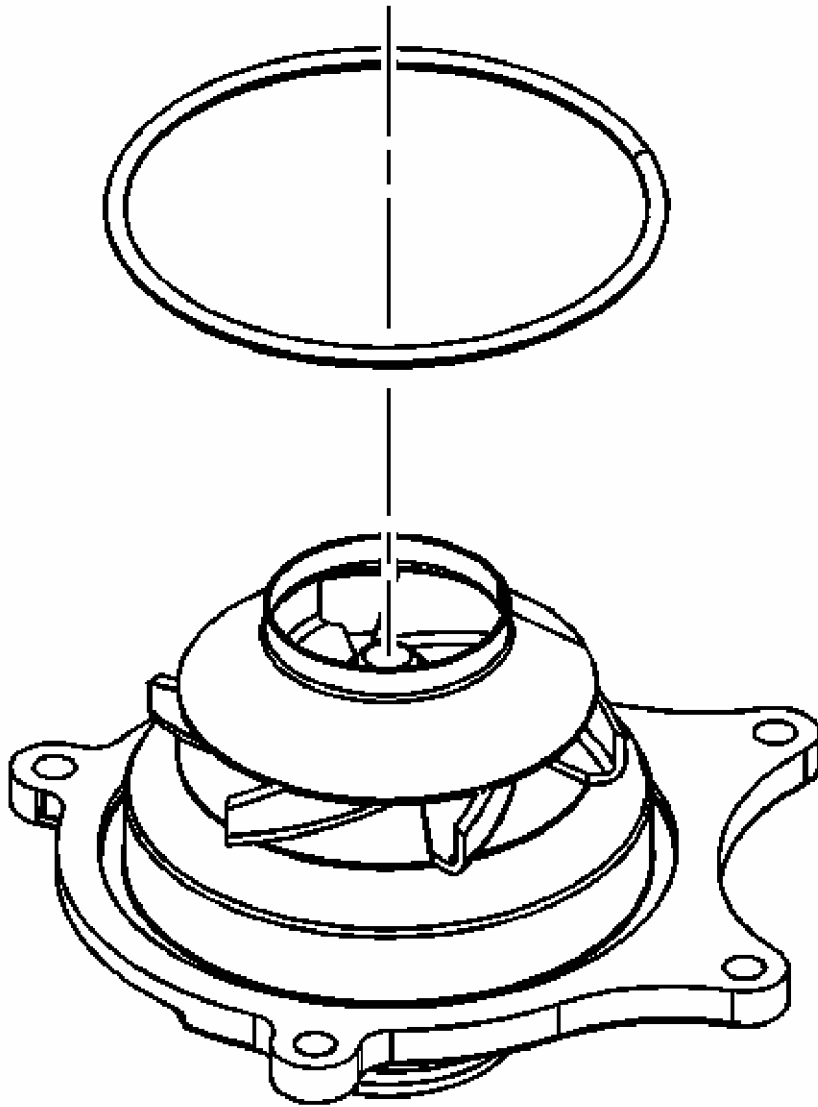




**Fig. 121: View Of Water Pump O-Ring Seal**  
**Courtesy of GENERAL MOTORS CORP.**

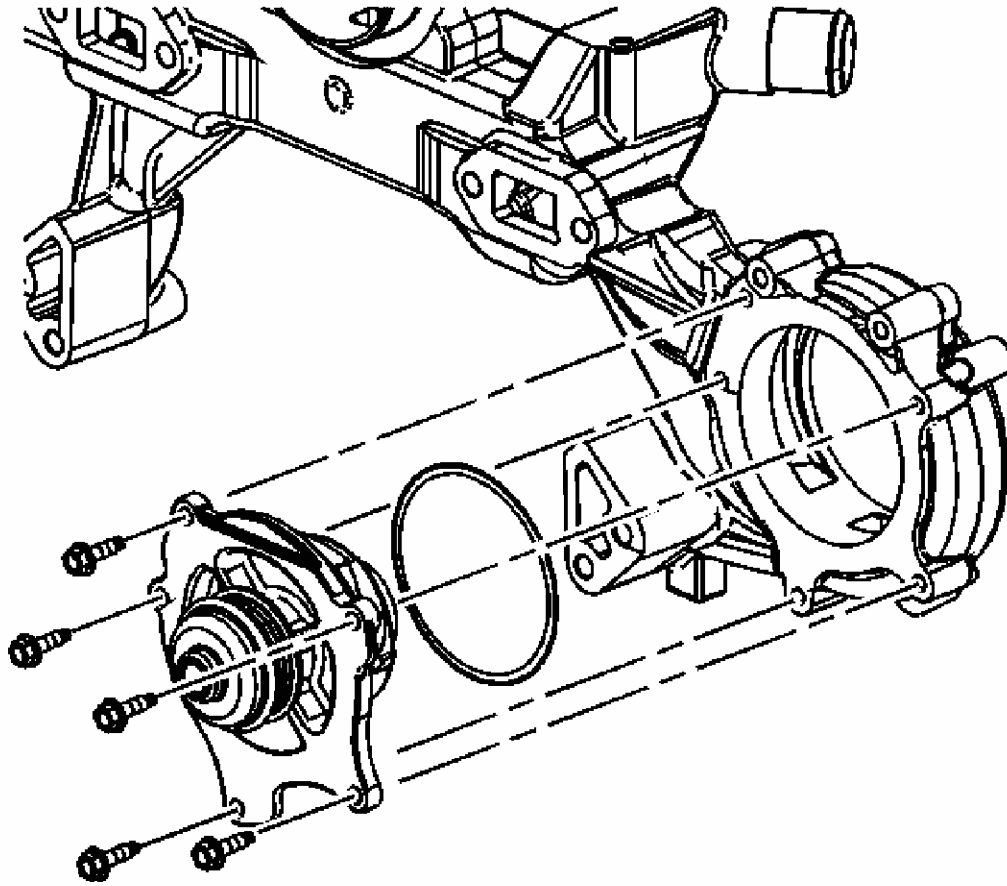
6. Remove and discard the water pump O-ring seal.

**Installation Procedure**



**Fig. 122: View Of Water Pump O-Ring Seal**  
**Courtesy of GENERAL MOTORS CORP.**

1. Install a NEW water pump O-ring seal.



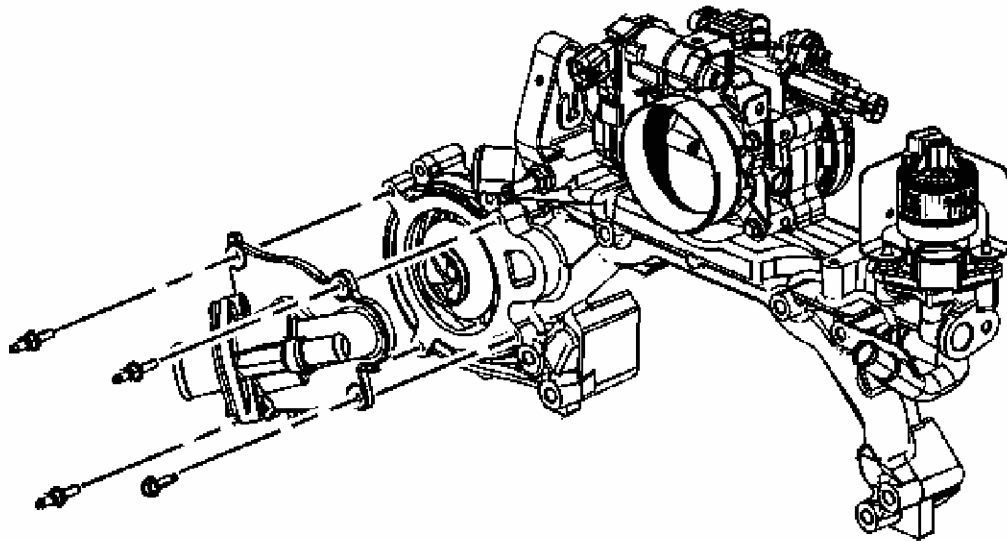
**Fig. 123: Identifying Water Pump Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

2. Install the water pump.

**NOTE:** Refer to Fastener Notice .

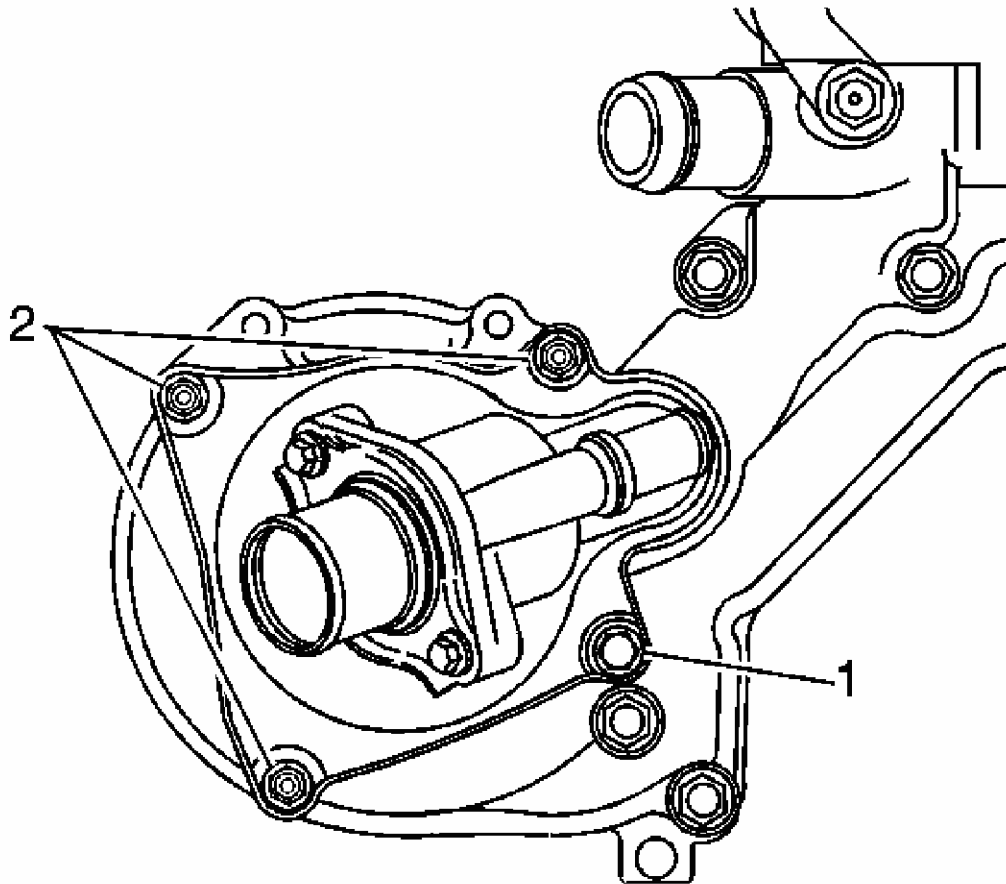
3. Install the water pump bolts.

**Tighten:** Tighten the bolts to 10 N.m (89 lb in).



**Fig. 124: Identifying Water Pump Cover Bolts/Studs**  
**Courtesy of GENERAL MOTORS CORP.**

4. Install the water pump cover.



**Fig. 125: Illustrating Proper Bolt & Stud Position**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** Ensure that the bolt is installed in the lower inboard position (1) and the studs are installed in the remaining positions (2).

5. Install the water pump cover bolt/studs.

**Tighten:** Tighten the bolt/studs to 10 N.m (89 lb in).

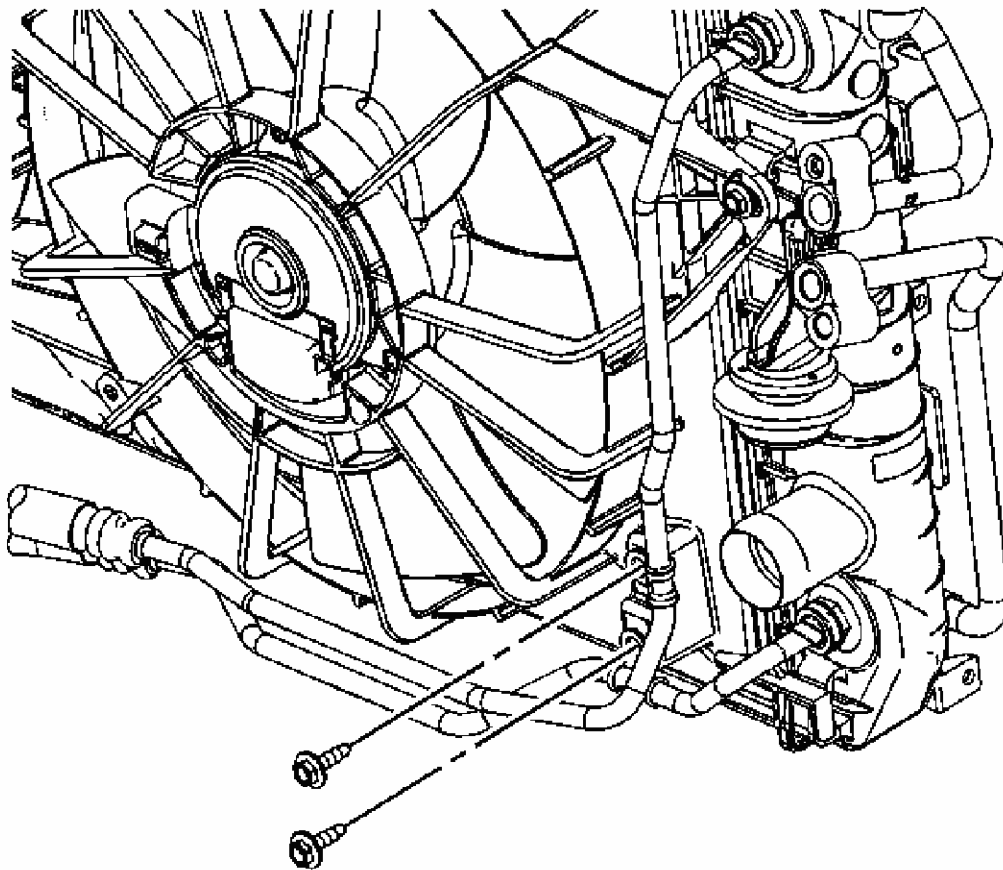
6. Install the water pump housing. Refer to **Engine Coolant Crossover Pipe Replacement (LD8)**.

## FAN SHROUD REPLACEMENT (L26)

### Tools Required

**J 38185 Hose Clamp Plier****Removal Procedure**

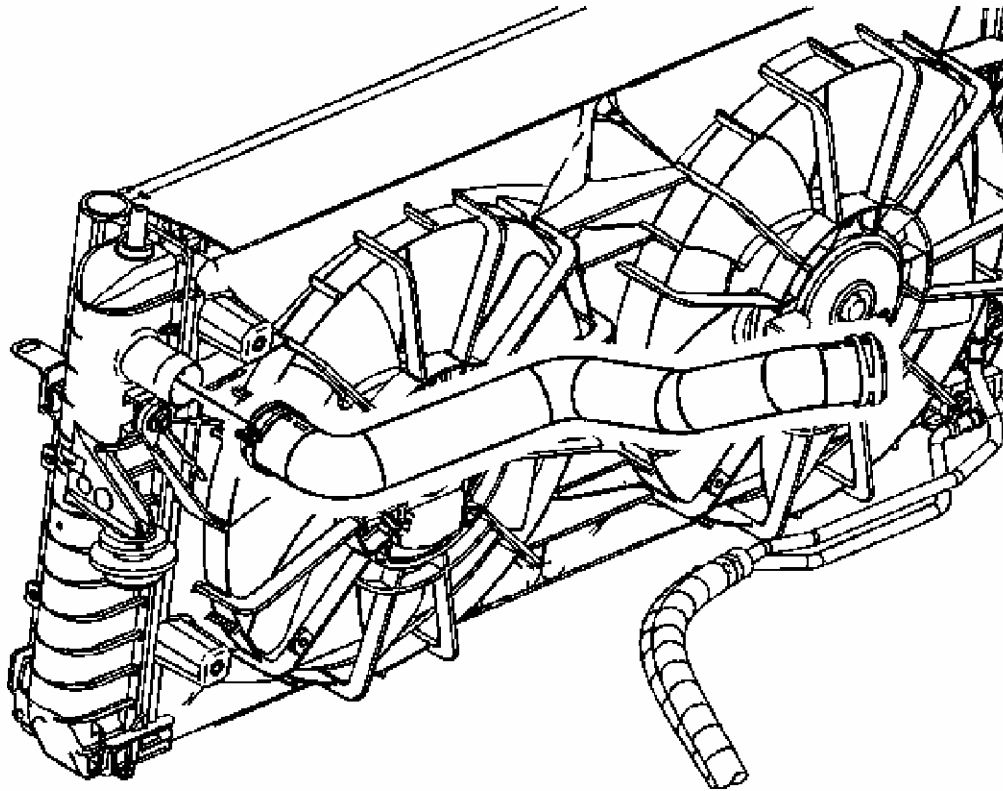
1. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .
2. Remove the condenser. Refer to **Condenser Replacement** .
3. Remove the upper tie bar. Refer to **Front End Upper Tie Bar Replacement** .
4. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac-N-Fill)**.
5. Remove the front air deflector. Refer to **Front Air Deflector Replacement** .



**Fig. 126: Identifying Transmission Oil Cooler Pipe Retaining Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

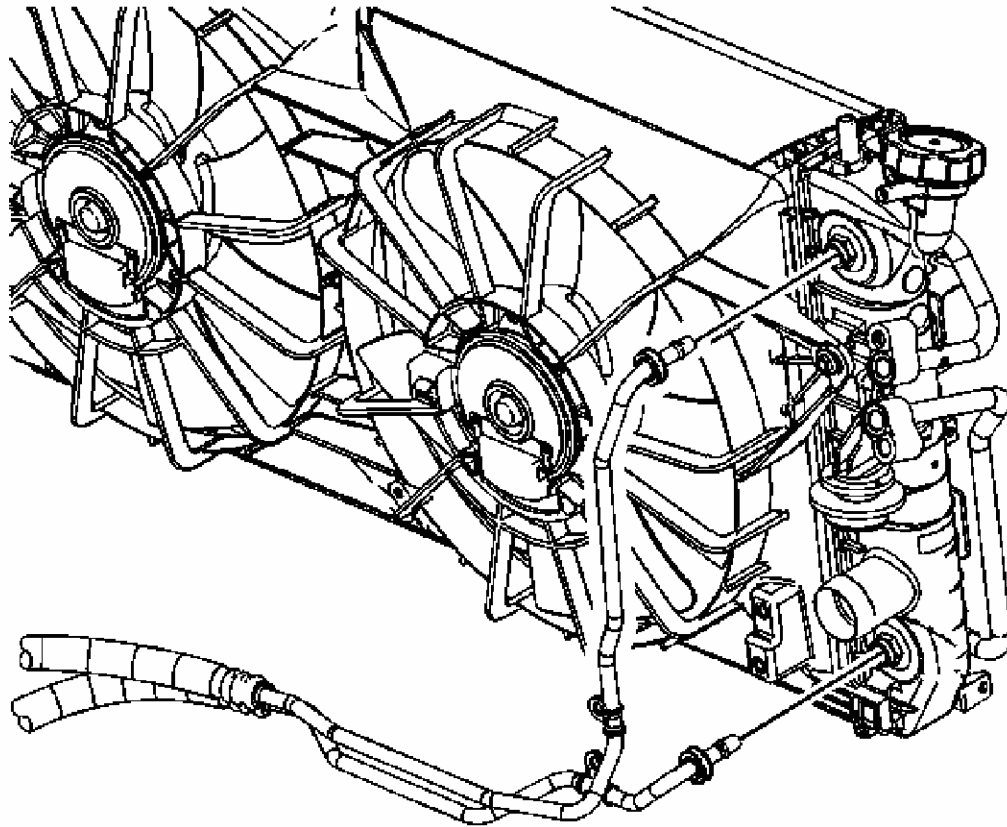
6. Remove the transmission oil cooler pipe retaining bolts from the fan shroud.

7. Lower the vehicle.



**Fig. 127: View Of Radiator Inlet Hose**  
**Courtesy of GENERAL MOTORS CORP.**

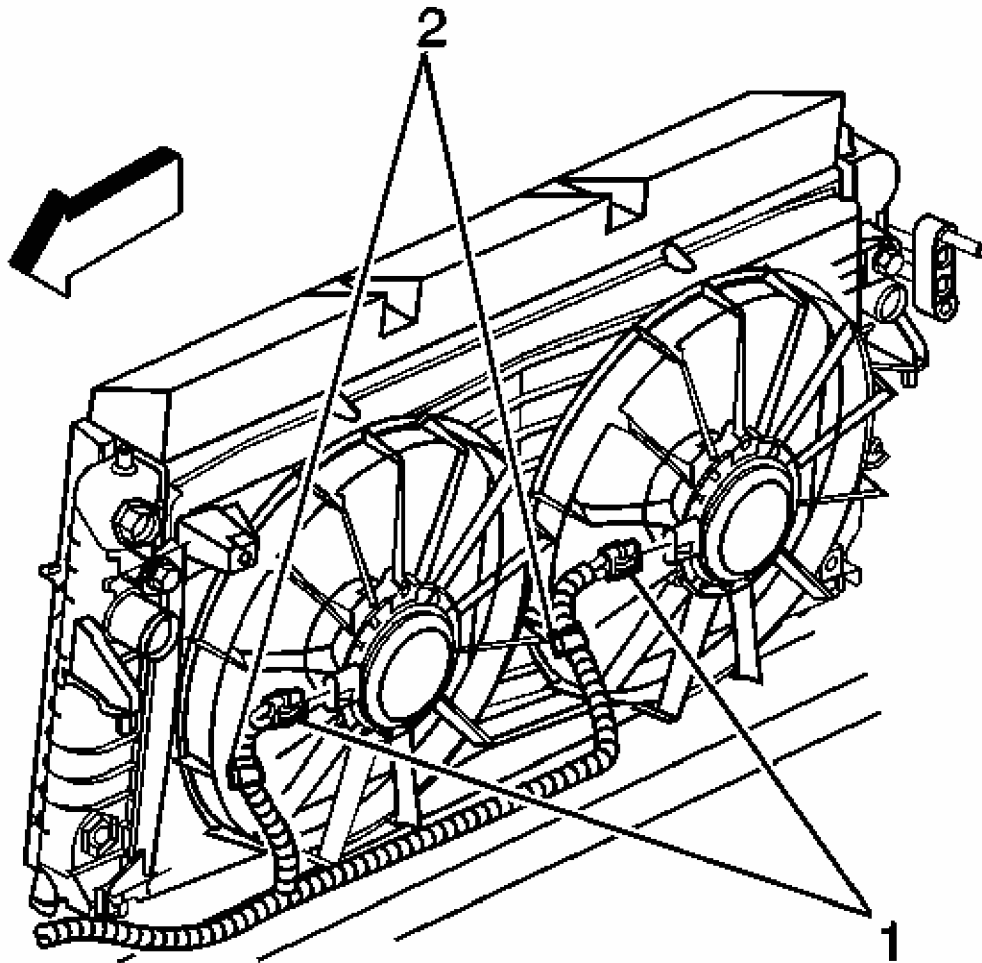
8. Using **J 38185** reposition the radiator inlet hose clamp.
9. Disconnect the radiator inlet hose from the radiator.



**Fig. 128: Removing/Installing Transmission Oil Cooler Lines**  
**Courtesy of GENERAL MOTORS CORP.**

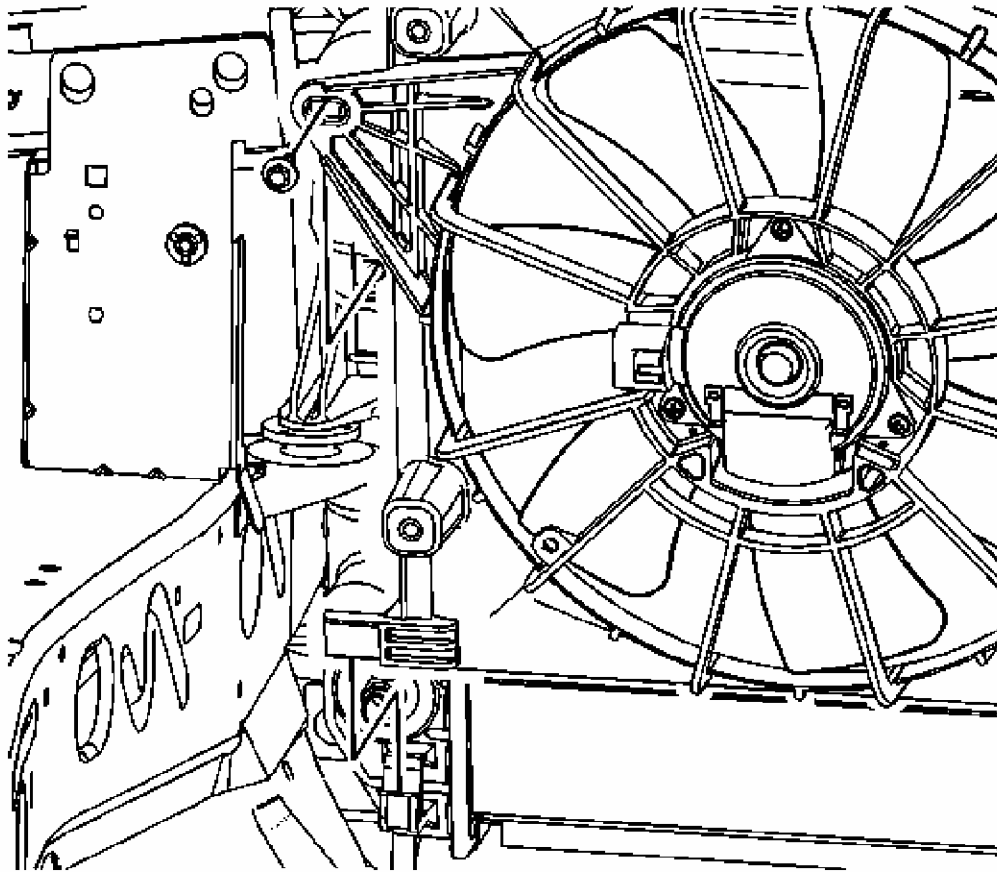
10. Slide the transmission oil cooler line caps reward to access the lines to the radiator.
11. Remove the transmission oil cooler lines from the radiator. Refer to **Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection** .





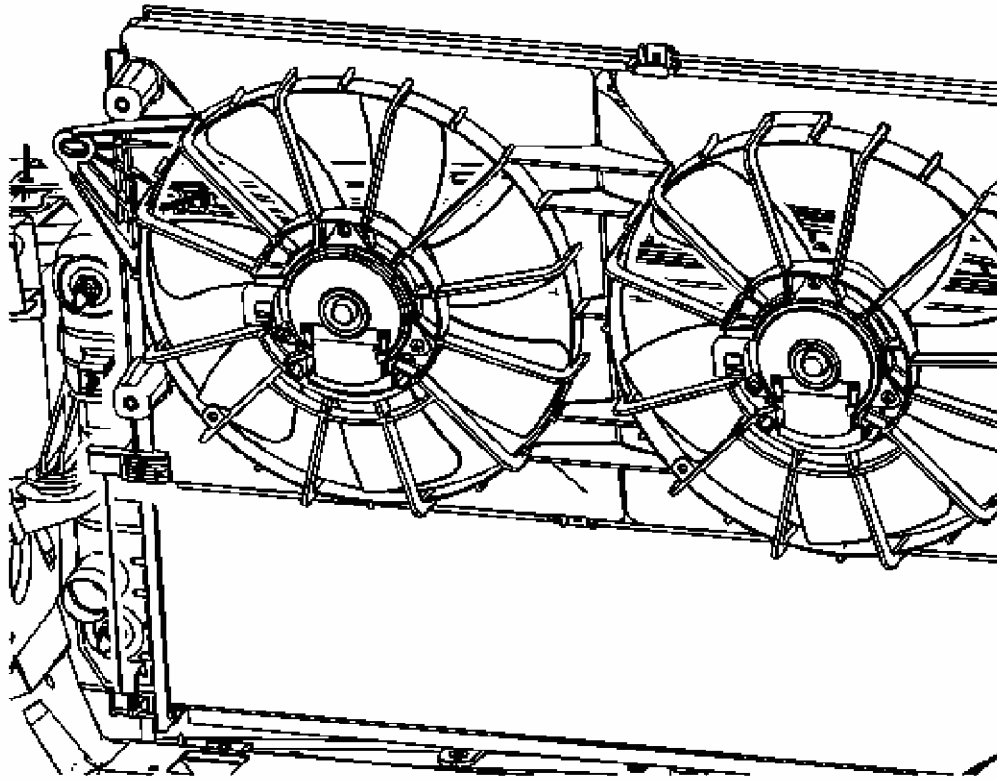
**Fig. 129: View of Cooling Fan Motor Electrical Connectors**  
**Courtesy of GENERAL MOTORS CORP.**

12. Disconnect the wiring harness electrical connectors (1) from the cooling fan motors.
13. Remove the clips (2) attaching the harness to the fan shroud.



**Fig. 130: View Of Fan Shroud Mounting Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

14. Remove the fan shroud mounting bolts.



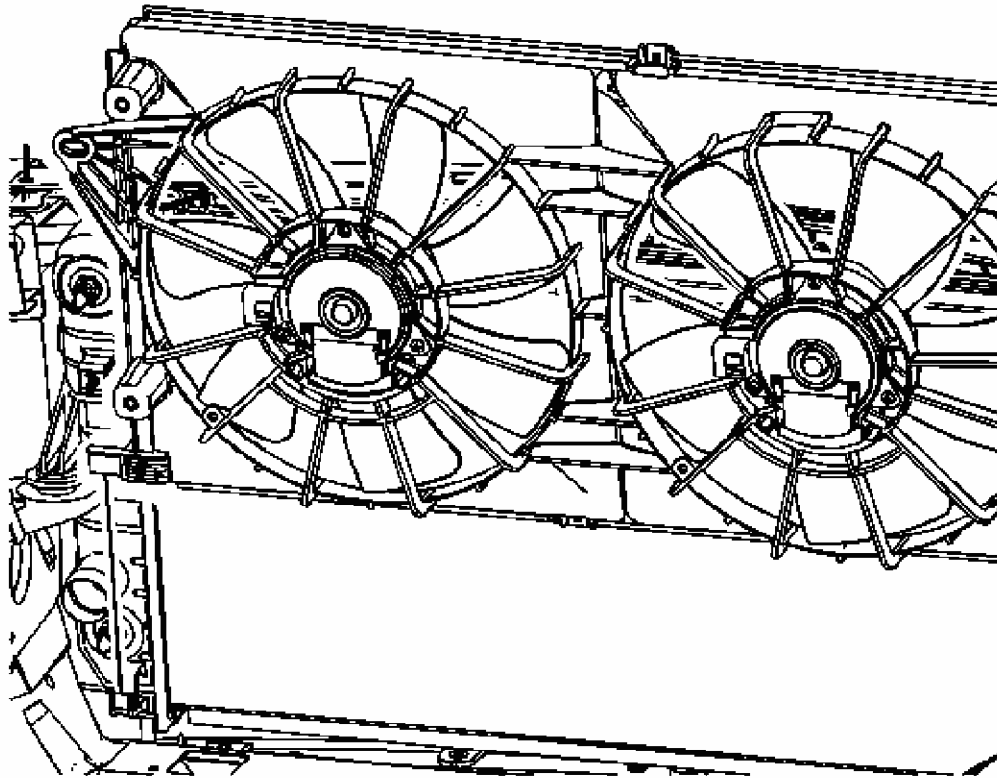
**Fig. 131: View Of Fan Shroud Assembly**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** Care should be taken when removing the fan shroud assembly not to damage the lower attachment points of both the fan shroud assembly and the radiator.

15. Remove the fan shroud assembly from the vehicle in the following order:
  1. Remove the clips at the top and bottom of the fan shroud.
  2. Position the fan shroud assembly towards the left side of the vehicle.
  3. Pull upward on the right side of the fan shroud assembly.
  4. Position the fan shroud assembly towards the right side of the vehicle.
  5. Pull upward on the fan shroud assembly removing the fan shroud assembly from the vehicle.
16. Remove the cooling fan motors when replacing the fan shroud assembly. Refer to **Engine Coolant Fan Motor Replacement**.

**Installation Procedure**

1. Install the cooling fan motors when replacing the fan shroud assembly. Refer to **Engine Coolant Fan Motor Replacement**.

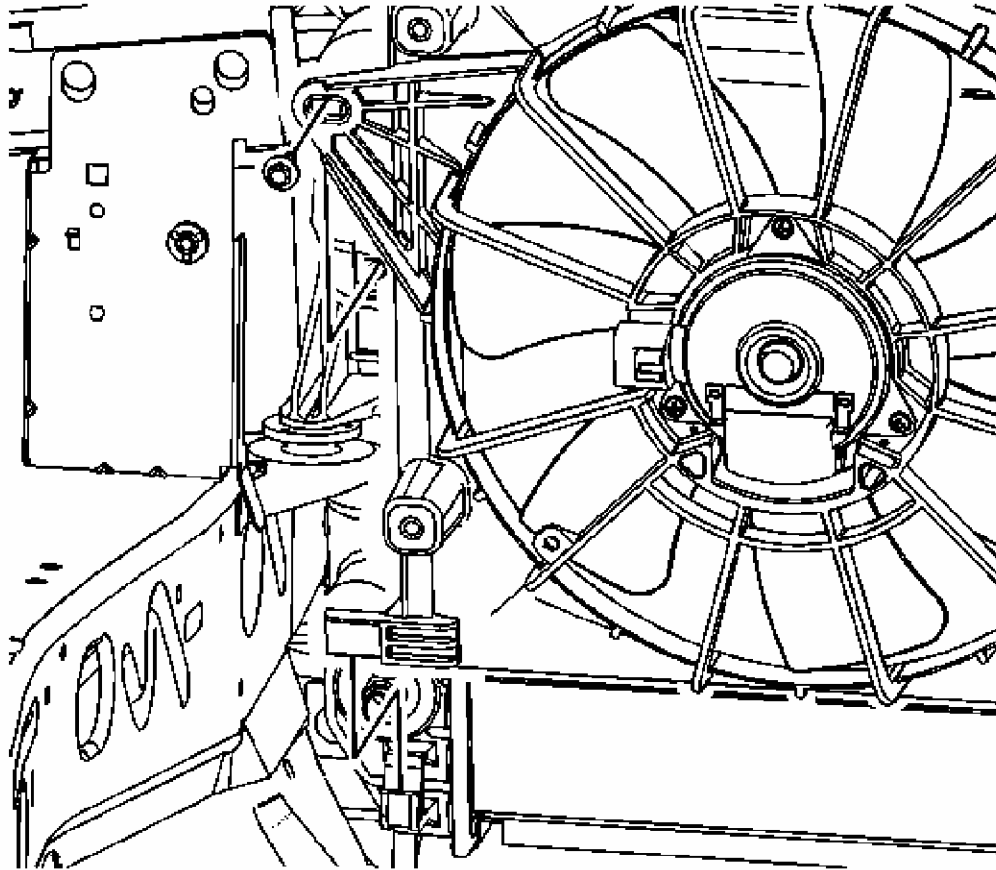


**Fig. 132: View Of Fan Shroud Assembly**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** Care should be taken when installing the fan shroud assembly not to damage the lower attachment points of both the fan shroud assembly and the radiator.

2. Install the fan shroud assembly to the vehicle in the following order:
  1. Position the fan shroud assembly behind the radiator.
  2. Position the fan shroud assembly towards the right side of the vehicle.
  3. Push downward on the right side of the fan shroud assembly.
  4. Move the fan shroud assembly into position, aligning the lower feet of the fan shroud to the mounting tabs on the radiator.

5. Install the clips at the top and bottom of the fan shroud.



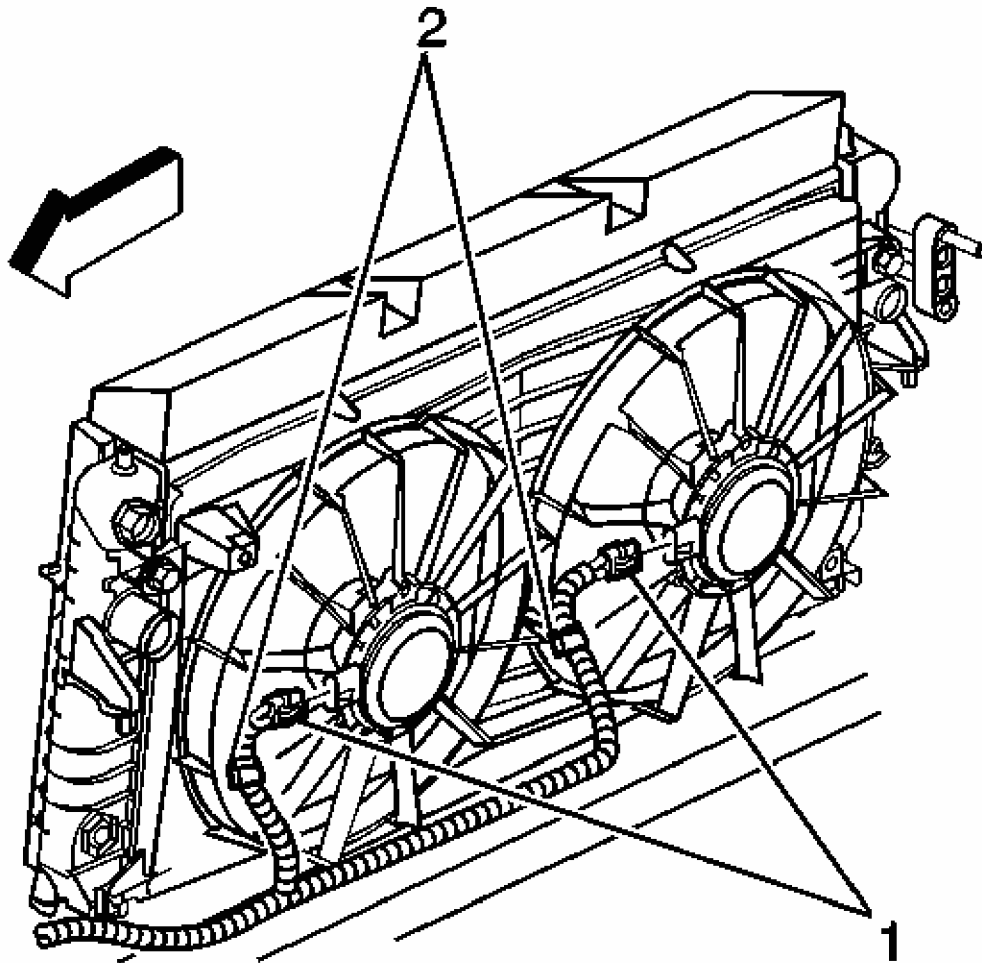
**Fig. 133: View Of Fan Shroud Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to Fastener Notice .

**IMPORTANT:** The bolts retaining the fan to the radiator end tanks are a special length and should be the **ONLY** bolts used upon reinstallation. The use of longer bolts will damage the radiator end tanks.

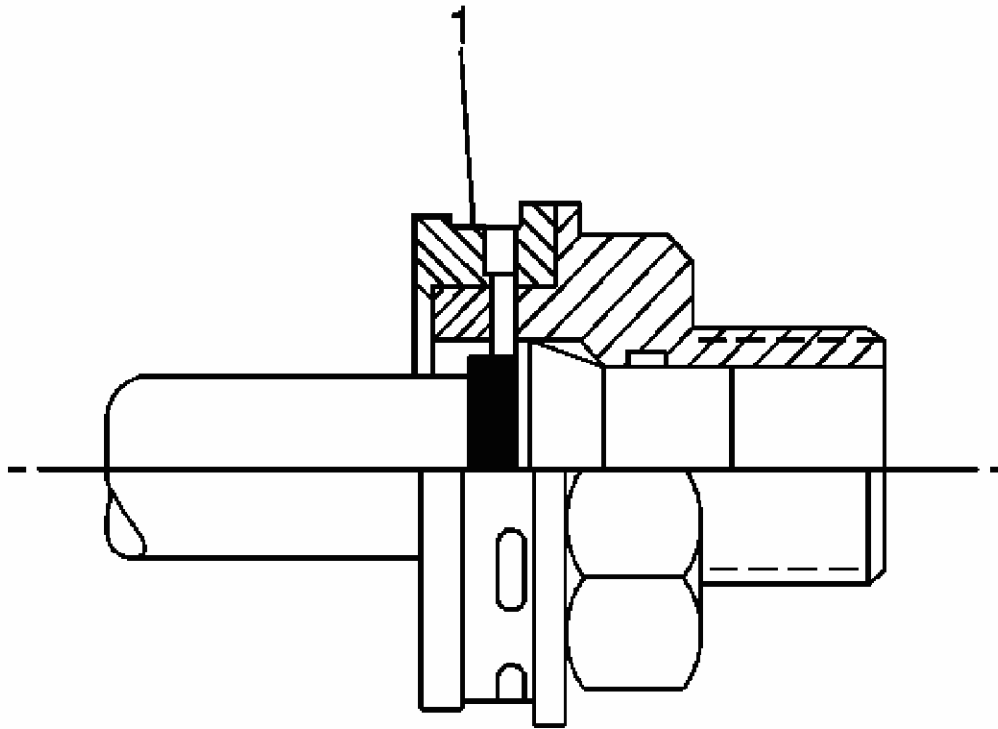
3. Install the fan shroud mounting bolts.

**Tighten:** Tighten the bolts to 6 N.m (53 lb in).



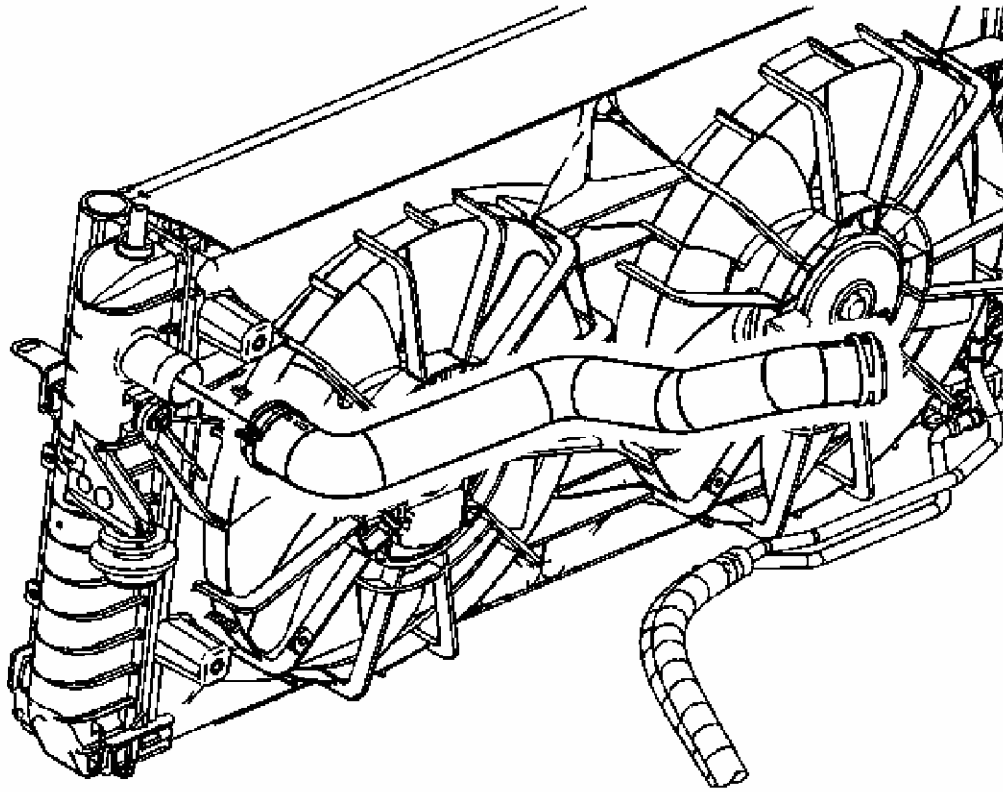
**Fig. 134: View of Cooling Fan Motor Electrical Connectors**  
**Courtesy of GENERAL MOTORS CORP.**

4. Connect the wiring harness electrical connectors (1) to the cooling fan motors.
5. Attach the wiring harness retaining clips (2) to the fan shroud.



**Fig. 135: View of Plastic Caps Over Quick Connect Joints**  
**Courtesy of GENERAL MOTORS CORP.**

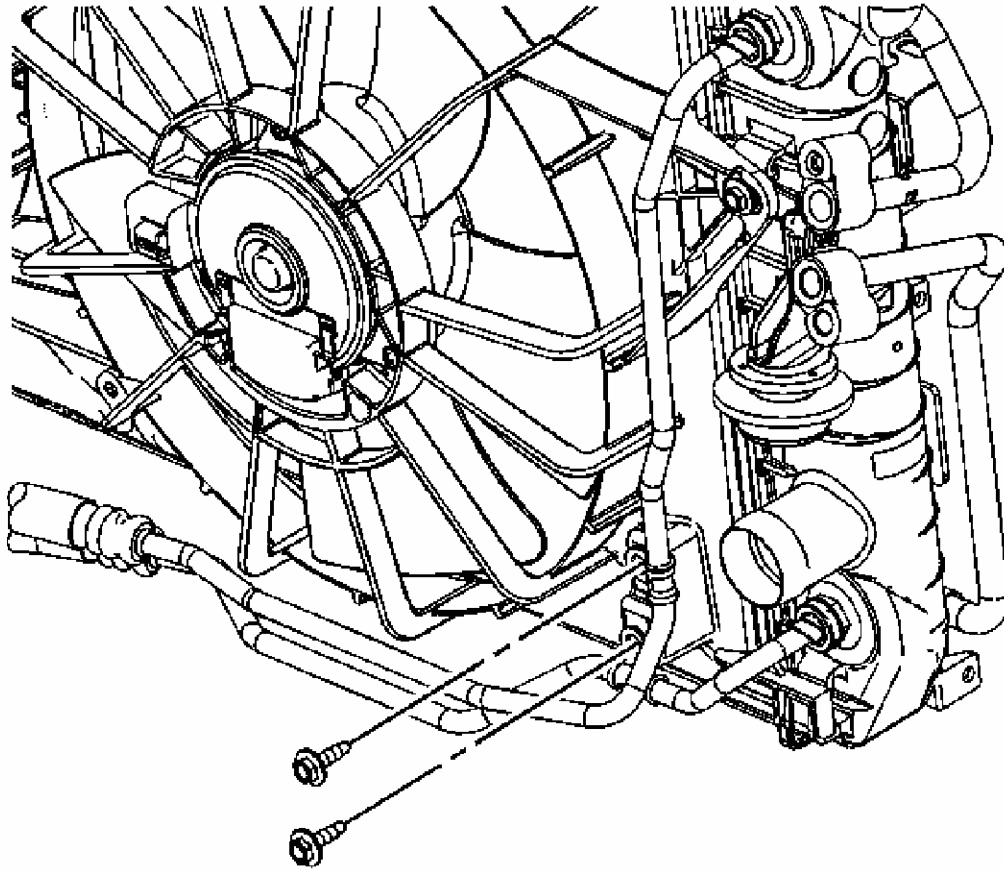
6. Push the transmission oil cooler pipe into the radiator quick connect fitting, until a "click" is heard.
7. Tug gently on the cooler pipe to ensure proper retention.
8. Slide the plastic cap (1) over the quick connect joint.



**Fig. 136: View Of Radiator Inlet Hose**  
**Courtesy of GENERAL MOTORS CORP.**

9. Install the radiator inlet hose to the radiator.
10. Using **J 38185** reposition the radiator inlet hose clamp.
11. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

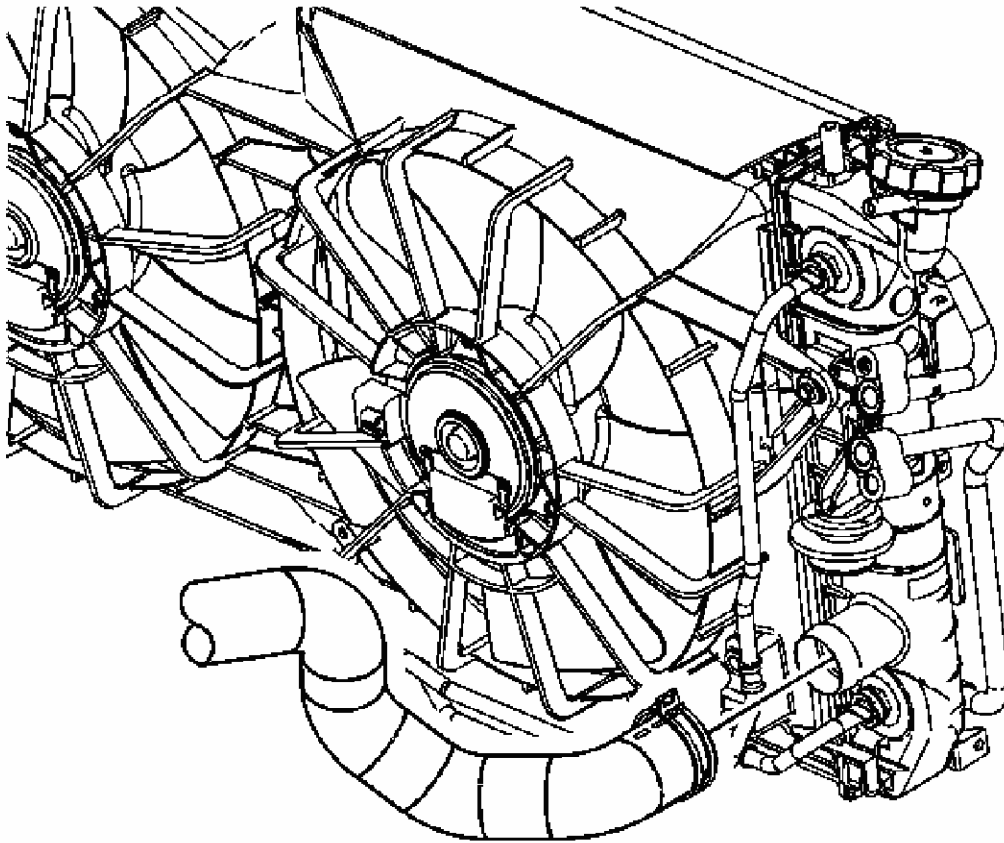




**Fig. 137: Identifying Transmission Oil Cooler Pipe Retaining Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

12. Install the transmission oil cooler pipe retaining bolts to the fan shroud.

**Tighten:** Tighten the bolts to 6 N.m (53 lb in).



**Fig. 138: Removing/Installing Radiator Outlet Hose**  
**Courtesy of GENERAL MOTORS CORP.**

13. Install the radiator outlet hose to the radiator.
14. Using **J 38185** reposition the radiator outlet hose clamp.
15. Install the front air deflector. Refer to **Front Air Deflector Replacement** .
16. Lower the vehicle.
17. Install the upper tie bar. Refer to **Front End Upper Tie Bar Replacement** .
18. Install the condenser. Refer to **Condenser Replacement** .
19. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac-N-Fill)**.
20. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .
21. Inspect the transmission oil level.

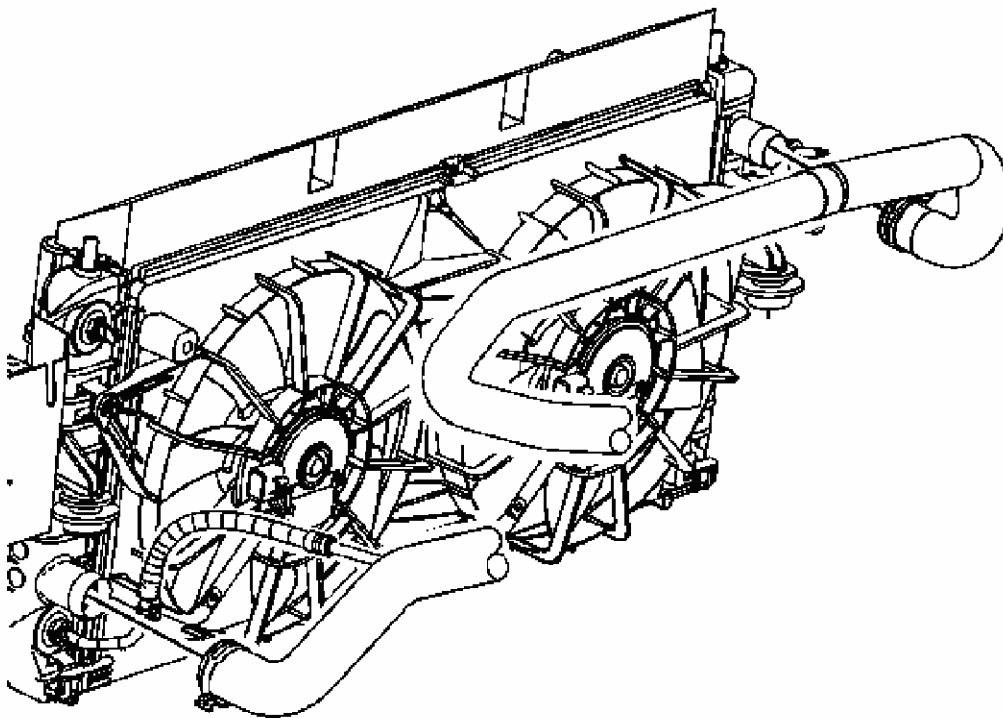
## **FAN SHROUD REPLACEMENT (LD8)**

### **Tools Required**

**J 38185** Hose Clamp Plier

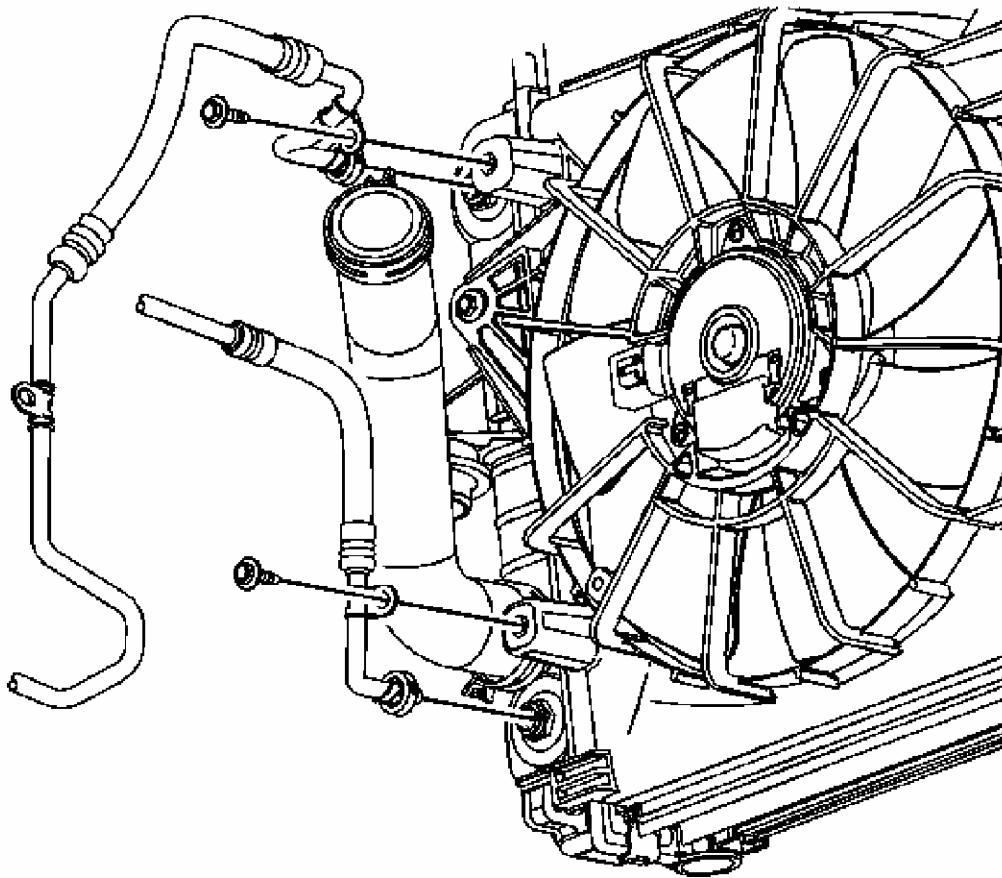
### **Removal Procedure**

1. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .
2. Remove the condenser. Refer to **Condenser Replacement** .
3. Remove the upper tie bar. Refer to **Front End Upper Tie Bar Replacement** .
4. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac-N-Fill)**.
5. Remove the front air deflector. Refer to **Front Air Deflector Replacement** .
6. Lower the vehicle.



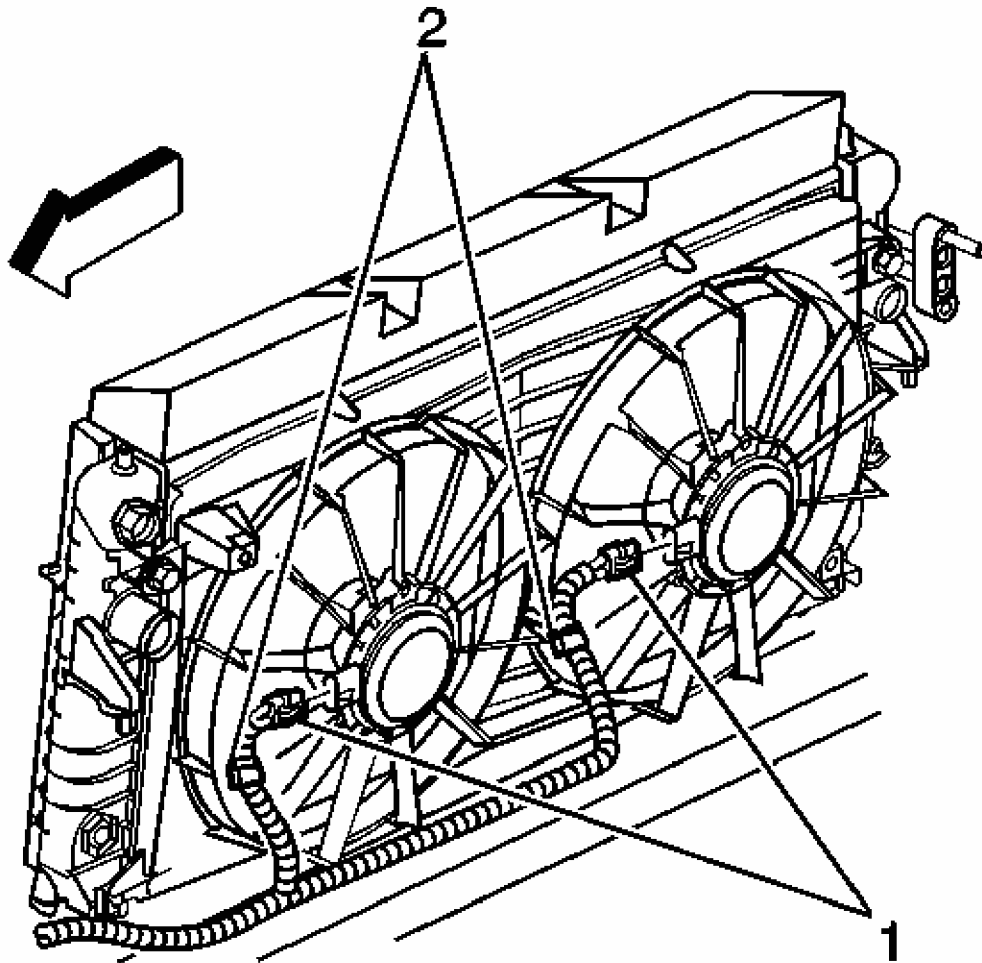
**Fig. 139: Identifying Radiator Outlet Hose**  
**Courtesy of GENERAL MOTORS CORP.**

7. Using **J 38185** reposition the radiator inlet hose clamp.
8. Disconnect the radiator inlet hose from the radiator.



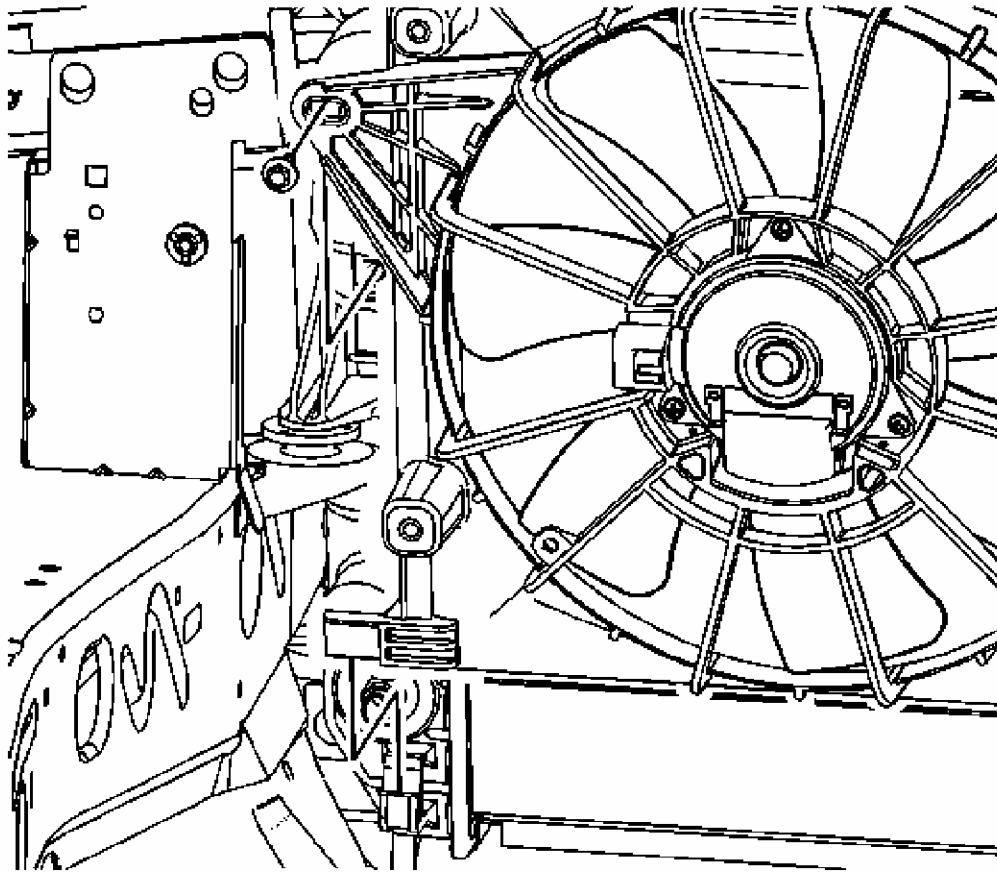
**Fig. 140: View Of Transmission Lines To Radiator**  
**Courtesy of GENERAL MOTORS CORP.**

9. Remove the transmission oil cooler pipe retaining bolts from the fan shroud.
10. Remove the transmission lines from the radiator. Refer to **Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection** .



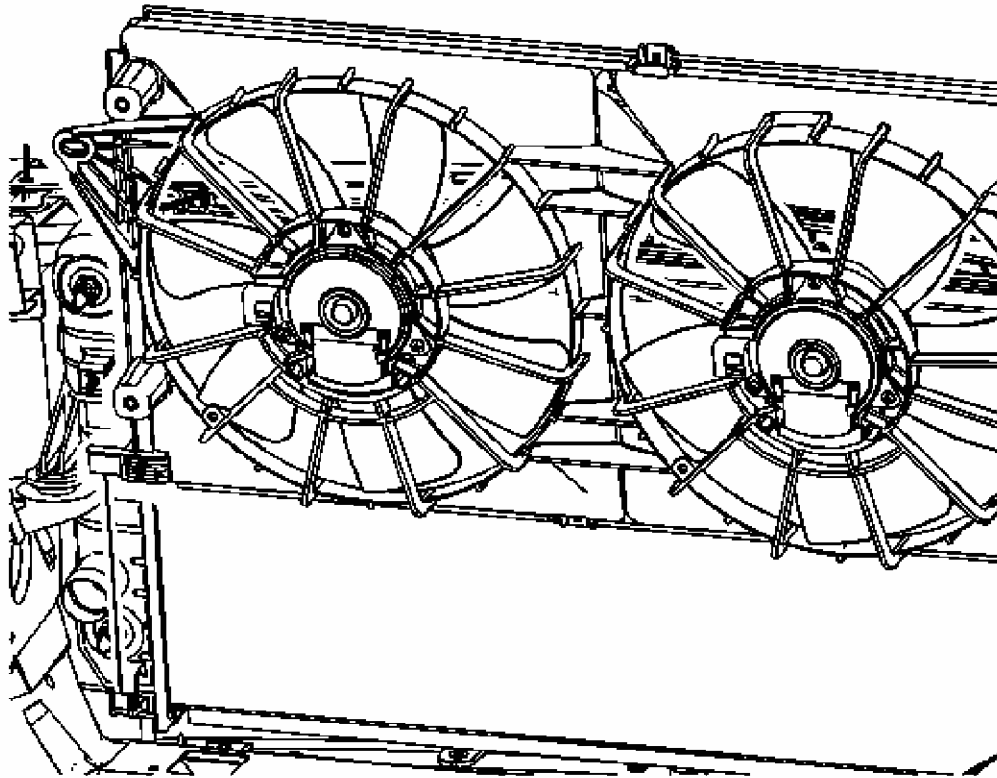
**Fig. 141: View of Cooling Fan Motor Electrical Connectors**  
**Courtesy of GENERAL MOTORS CORP.**

11. Disconnect the wiring harness electrical connectors (1) from the cooling fan motors.
12. Remove the clips (2) attaching the harness to the fan shroud.



**Fig. 142: View Of Fan Shroud Mounting Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

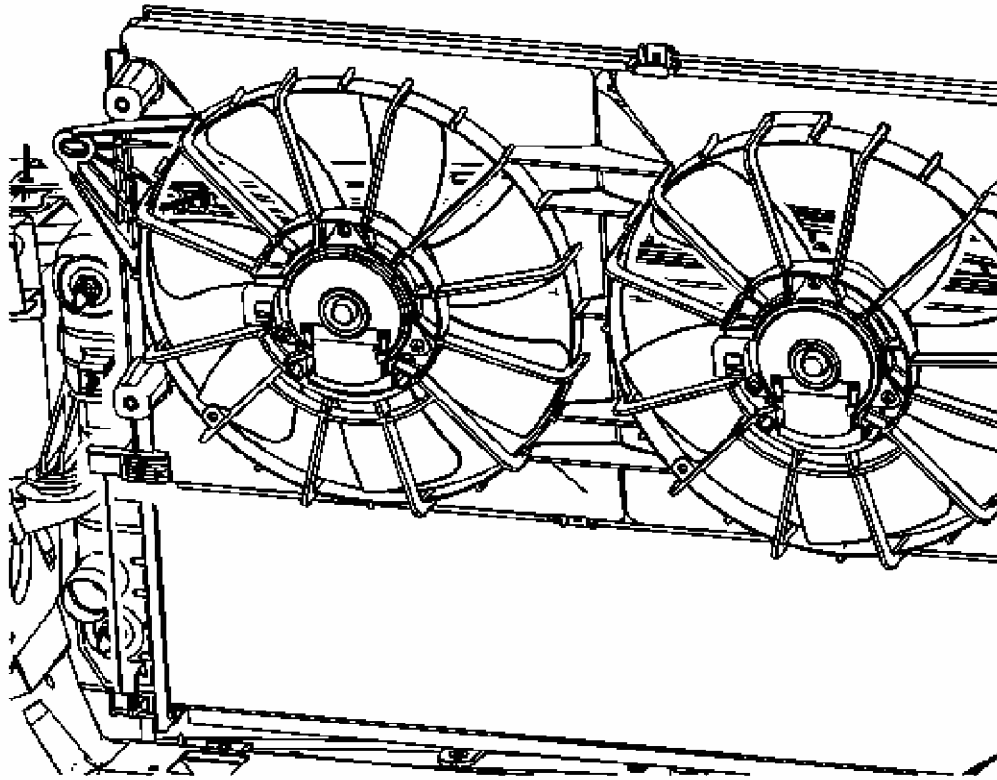
13. Remove the fan shroud mounting bolts.



**Fig. 143: View Of Fan Shroud Assembly**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** Care should be taken when removing the cooling fan assembly not to damage the lower attachment points of both the cooling fan assembly and radiator.

14. Remove the fan shroud assembly from the vehicle in the following order:
  1. Position the fan shroud assembly towards the left side of the vehicle.
  2. Pull upward on the right side of the fan shroud assembly.
  3. Position the fan shroud assembly towards the right side of the vehicle.
  4. Pull upward on the fan shroud assembly removing the fan shroud assembly from the vehicle.

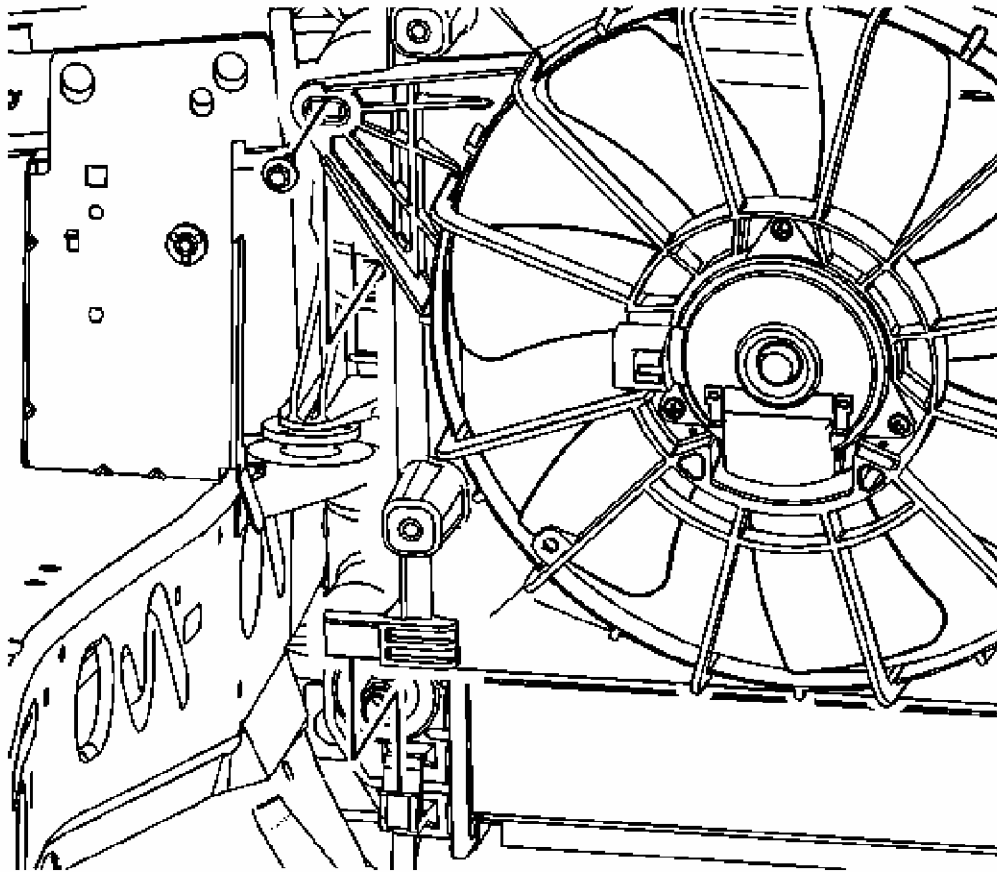


**Fig. 144: View Of Fan Shroud Assembly**  
**Courtesy of GENERAL MOTORS CORP.**

**IMPORTANT:** Care should be taken when installing the cooling fan assembly not to damage the lower attachment points of both the cooling fan assembly and radiator.

1. Install the fan shroud assembly to the vehicle in the following order:
  1. Position the fan shroud assembly behind the radiator.
  2. Position the fan shroud assembly towards the right side of the vehicle.
  3. Push downward on the right side of the fan shroud assembly.
  4. Move the fan shroud assembly into position, aligning the lower feet of the fan shroud to the mounting tabs on the radiator.





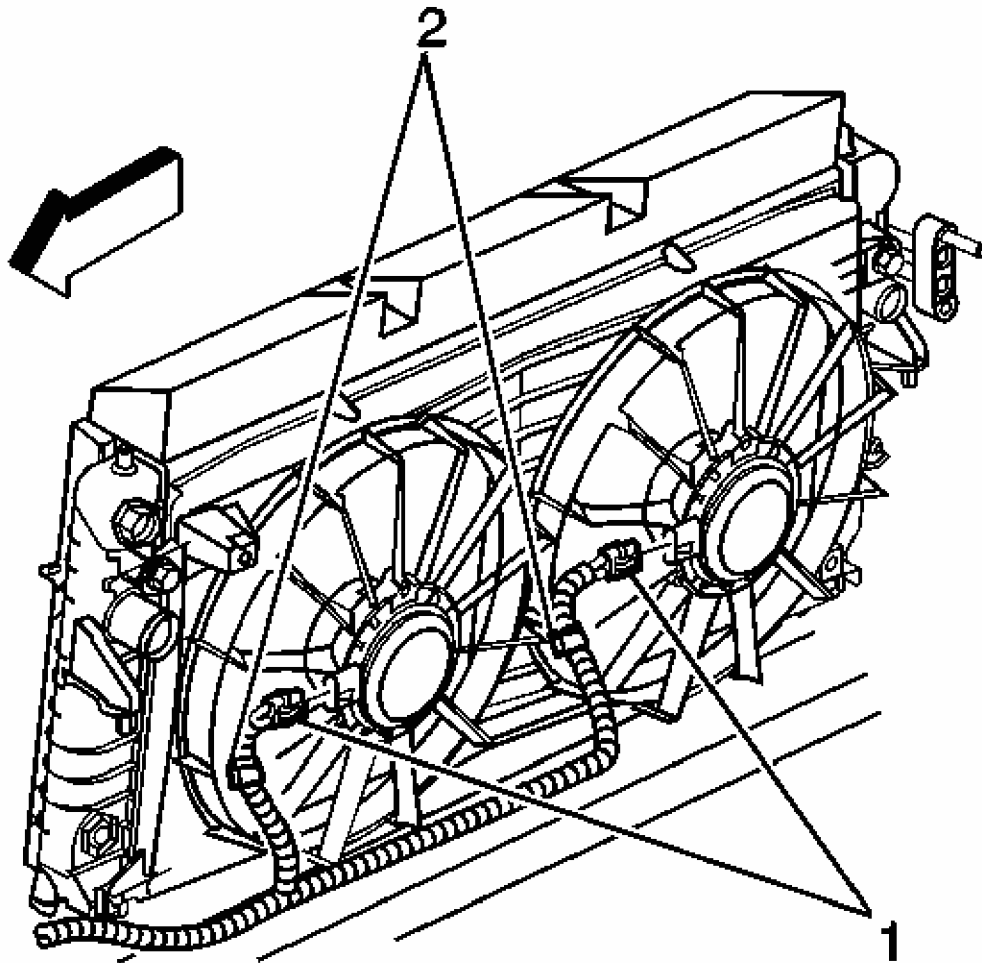
**Fig. 145: View Of Fan Shroud Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to Fastener Notice .

**IMPORTANT:** The bolts retaining the cooling fan to the radiator end tanks are a special length and should be the **ONLY** bolts used upon reinstallation. The use of longer bolts will damage the radiator end tanks.

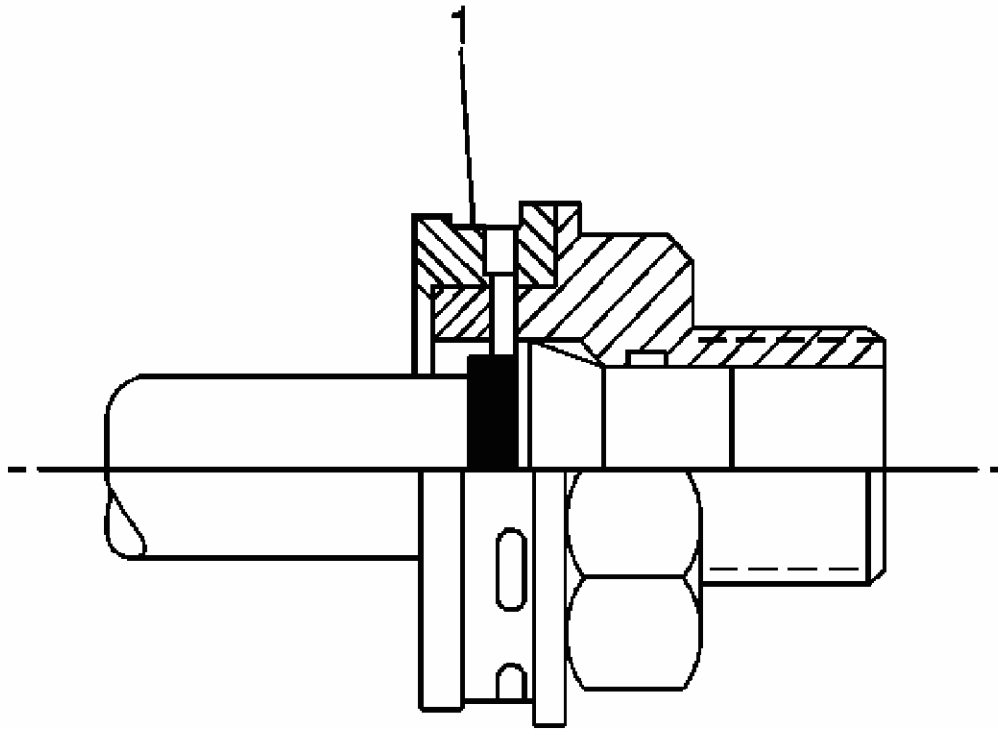
2. Install the fan shroud mounting bolts.

**Tighten:** Tighten the bolts to 6 N.m (53 lb in).



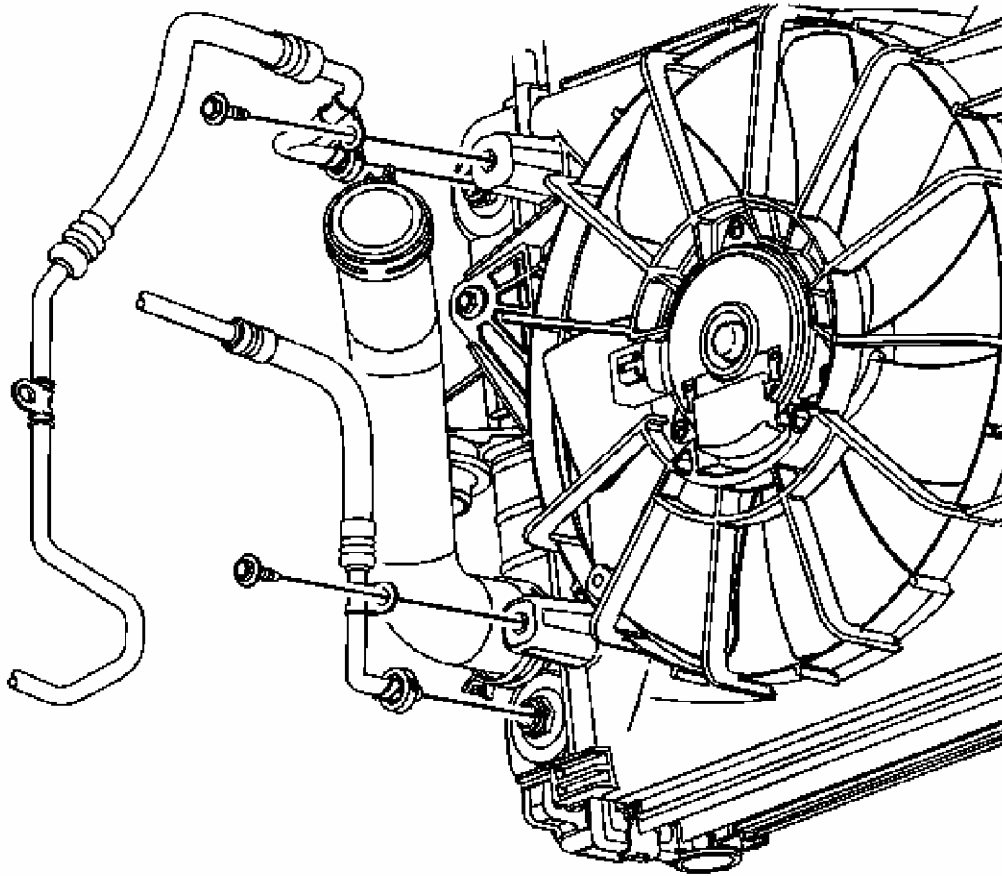
**Fig. 146: View of Cooling Fan Motor Electrical Connectors**  
**Courtesy of GENERAL MOTORS CORP.**

3. Connect the wiring harness electrical connectors (1) to the cooling fan motors.
4. Attach the wiring harness retaining clips (2) to the fan shroud.



**Fig. 147: View of Plastic Caps Over Quick Connect Joints**  
**Courtesy of GENERAL MOTORS CORP.**

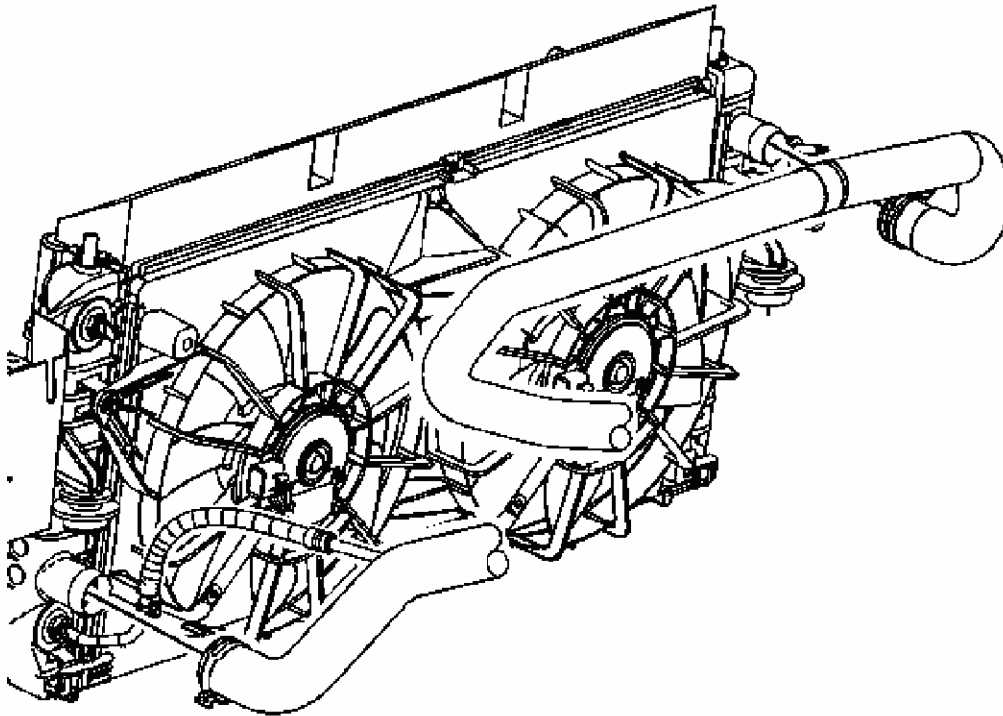
5. Push the upper transaxle oil cooler pipe into the radiator quick connect fitting, until a "click" is heard.
6. Tug gently on the cooler pipe to ensure proper retention.
7. Slide the plastic cap (1) over the quick connect joint.



**Fig. 148: View Of Transmission Lines To Radiator**  
**Courtesy of GENERAL MOTORS CORP.**

8. Install the transmission oil cooler pipe retaining bolts to the fan shroud.

**Tighten:** Tighten the bolts to 6 N.m (53 lb in).



**Fig. 149: Identifying Radiator Outlet Hose**  
**Courtesy of GENERAL MOTORS CORP.**

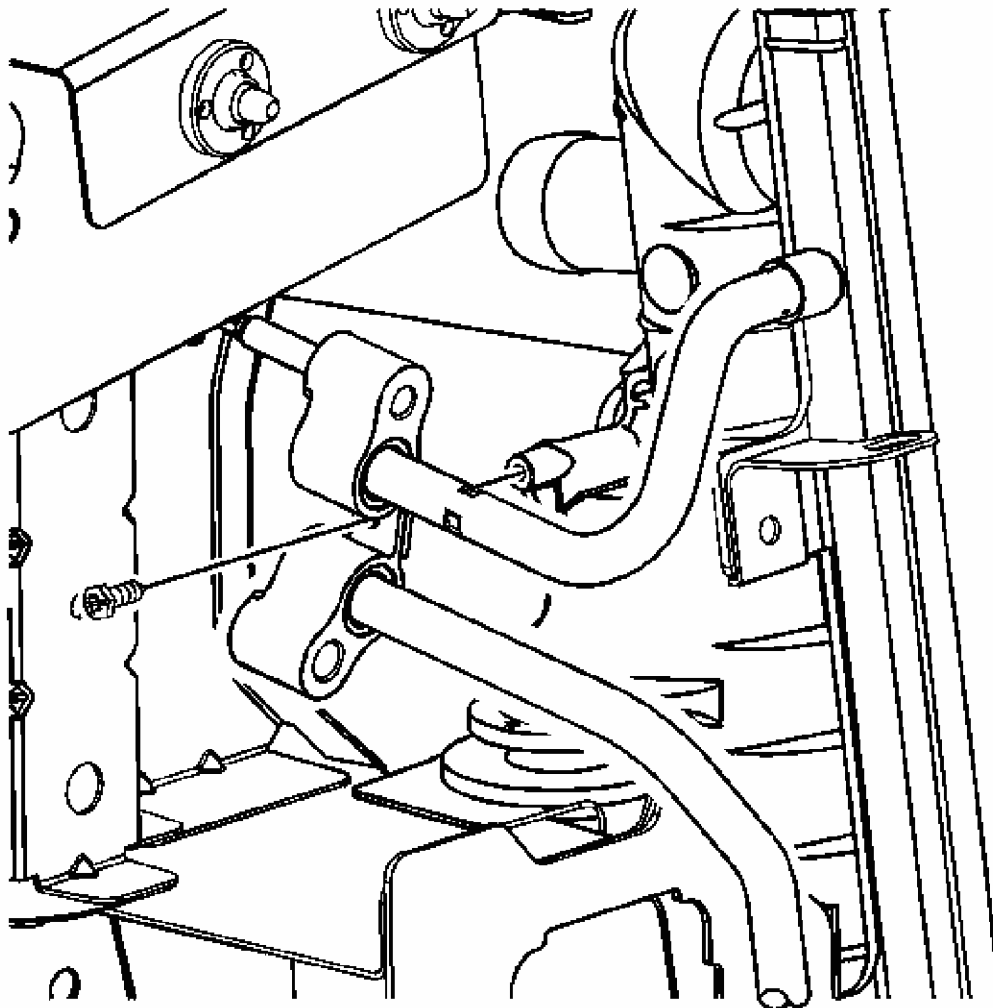
9. Install the radiator inlet hose to the radiator.
10. Using **J 38185** reposition the radiator inlet hose clamp.
11. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
12. Install the front air deflector. Refer to **Front Air Deflector Replacement** .
13. Lower the vehicle.
14. Install the upper tie bar. Refer to **Front End Upper Tie Bar Replacement** .
15. Install the condenser. Refer to **Condenser Replacement** .
16. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac-N-Fill)**.
17. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .
18. Inspect the engine oil level.

**Tools Required**

**J 38185** Hose Clamp Pliers

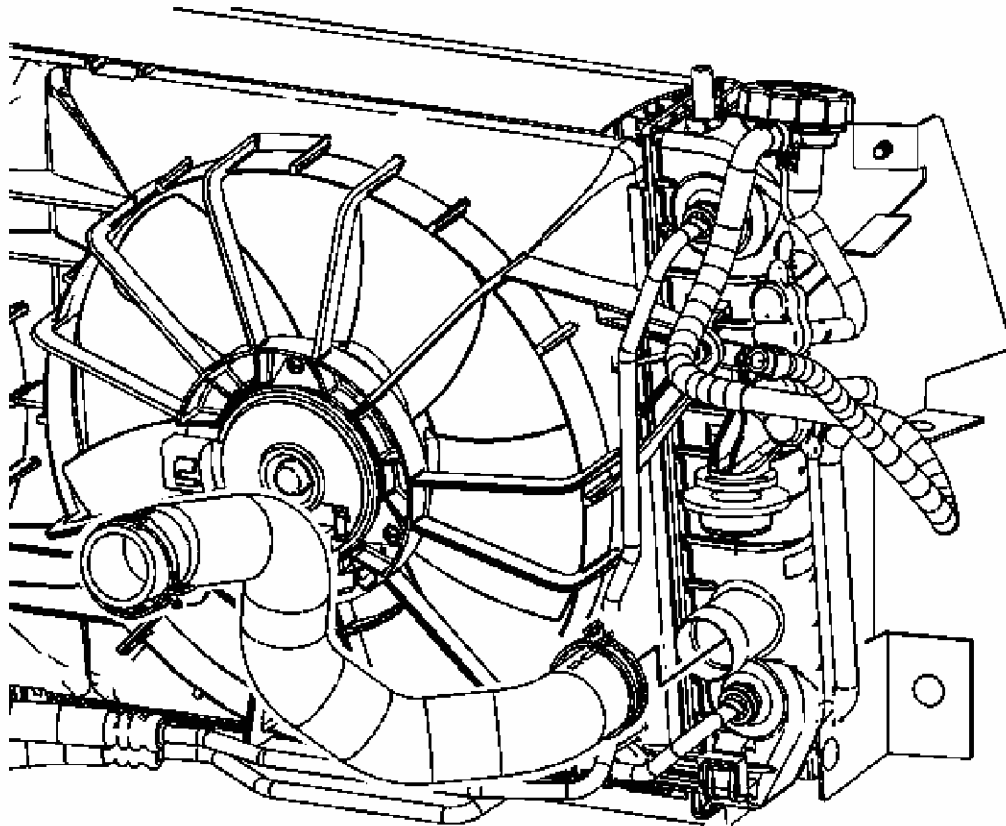
**Removal Procedure**

1. Partially drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac-N-Fill)**.
2. Remove the cooling fan shroud assembly. Refer to **Fan Shroud Replacement (L26)** or **Fan Shroud Replacement (LD8)**.



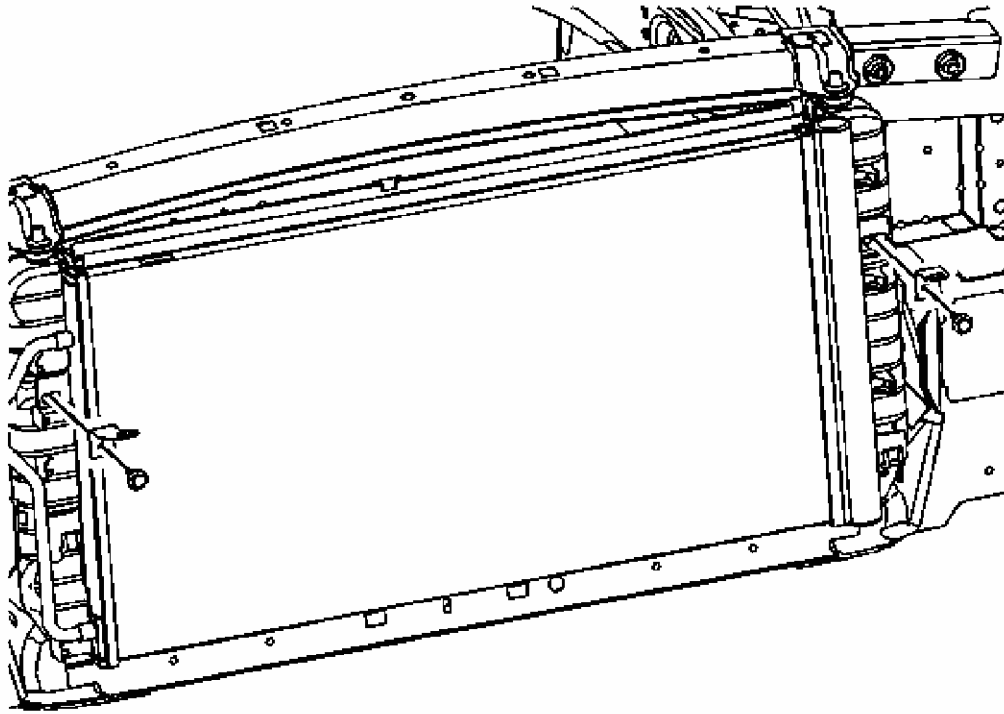
**Fig. 150: Removing/Installing Condenser Lines**  
Courtesy of GENERAL MOTORS CORP.

3. Remove the condenser line to radiator retaining bolt.



**Fig. 151: View Of Radiator Outlet Hose**  
**Courtesy of GENERAL MOTORS CORP.**

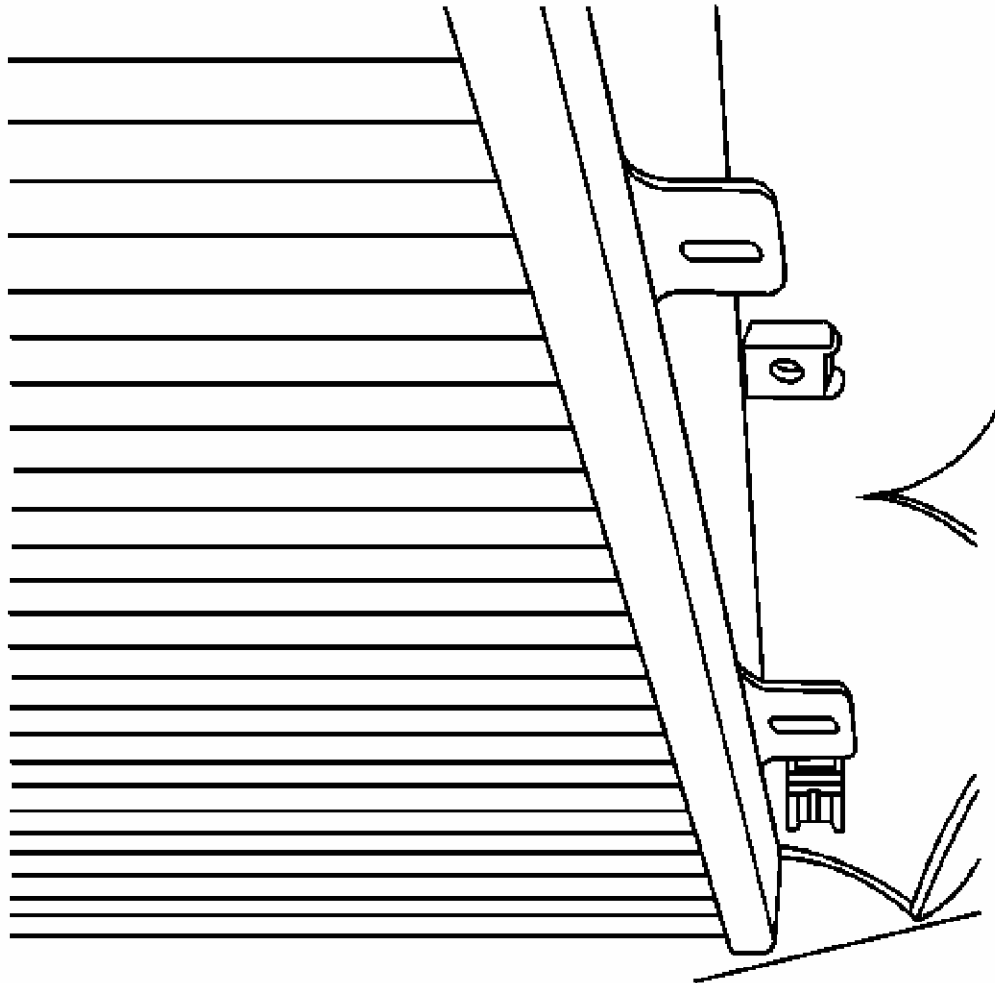
4. Using **J 38185** reposition the hose clamps from the radiator outlet hose.
5. Remove the radiator outlet hose from the radiator.



**Fig. 152: View Of Condenser & Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

6. Remove the condenser mounting bolts.

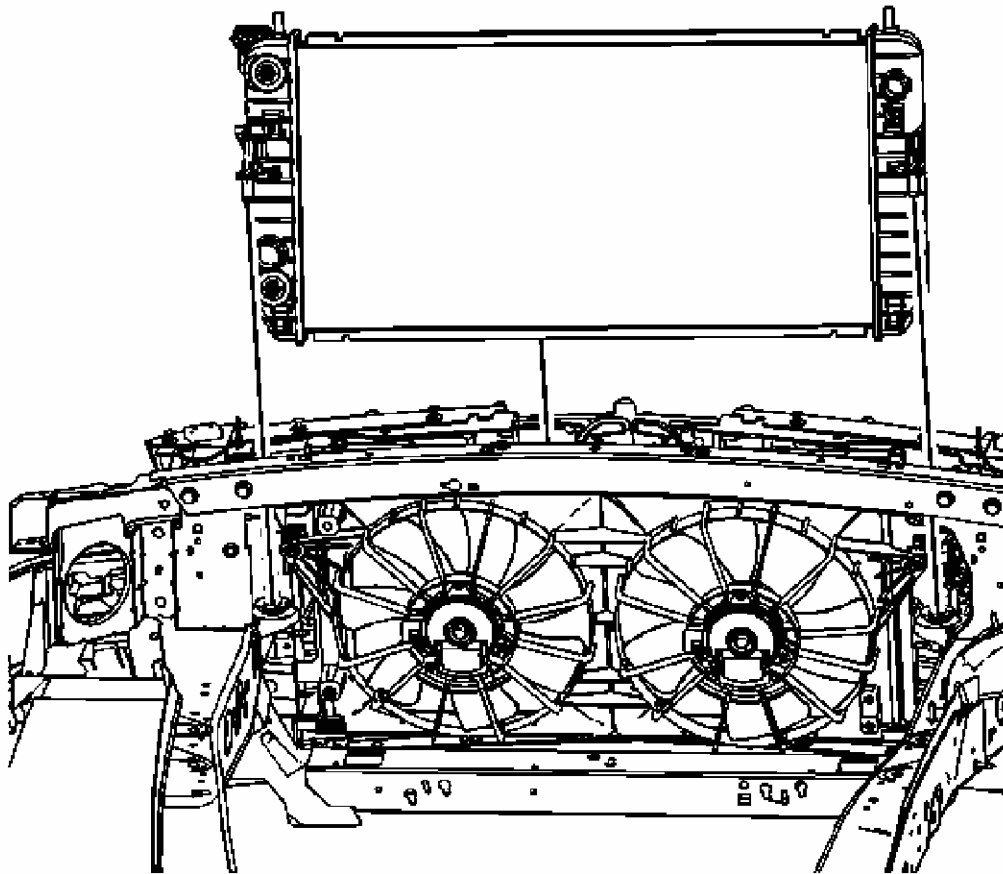




**Fig. 153: Locating Condenser Lower Attachment Points**  
**Courtesy of GENERAL MOTORS CORP.**

**IMPORTANT:** Care should be taken when removing the condenser not to damage the lower attachment points of both the radiator and condenser.

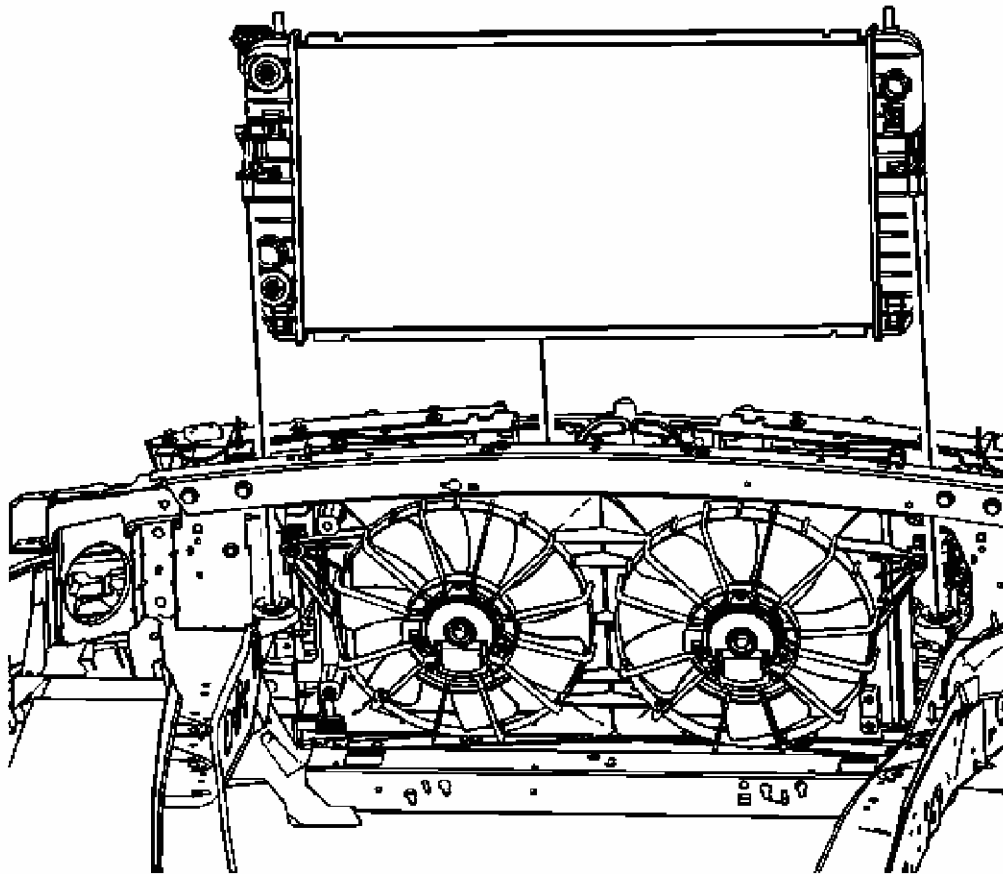
7. Lift the condenser upward slightly in order to release the lower feet from the lower mounting features located at the front of the radiator.



**Fig. 154: Removing/Installing Radiator**  
**Courtesy of GENERAL MOTORS CORP.**

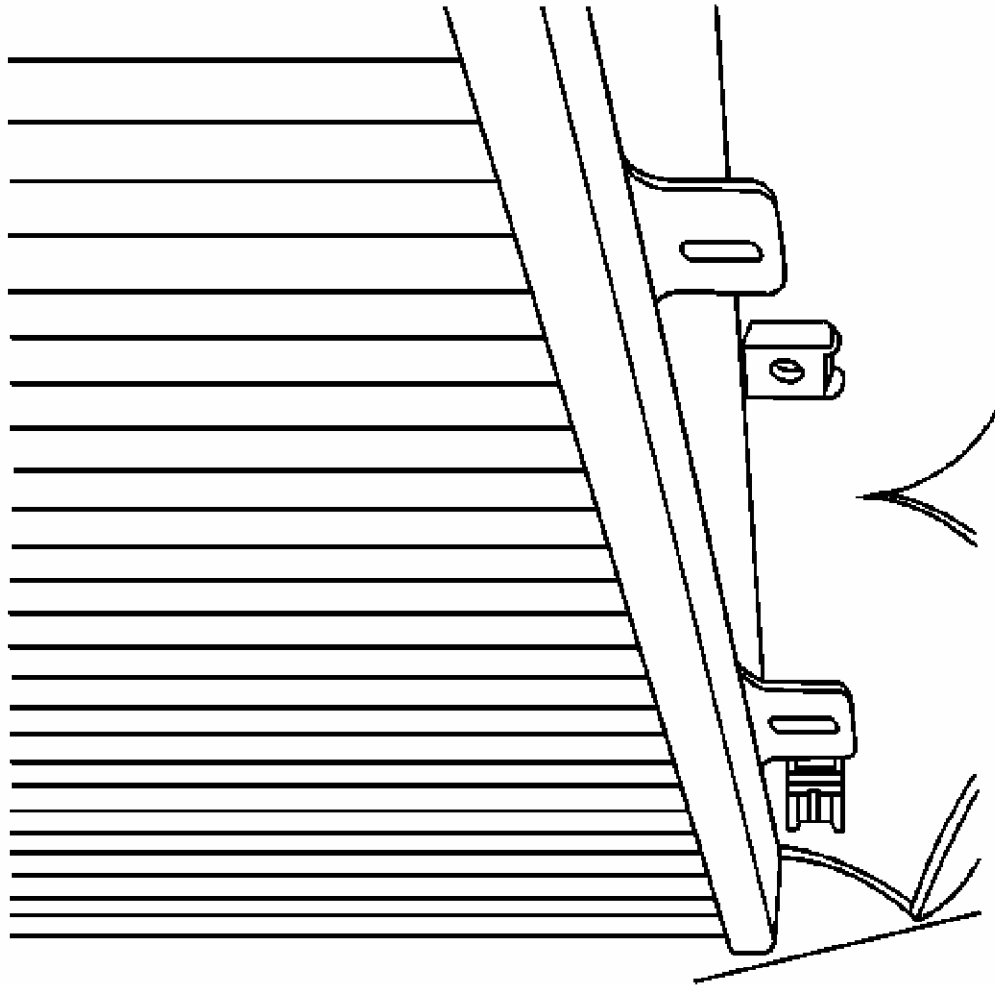
8. Lift the radiator up and out the vehicle.

**Installation Procedure**



**Fig. 155: Removing/Installing Radiator**  
**Courtesy of GENERAL MOTORS CORP.**

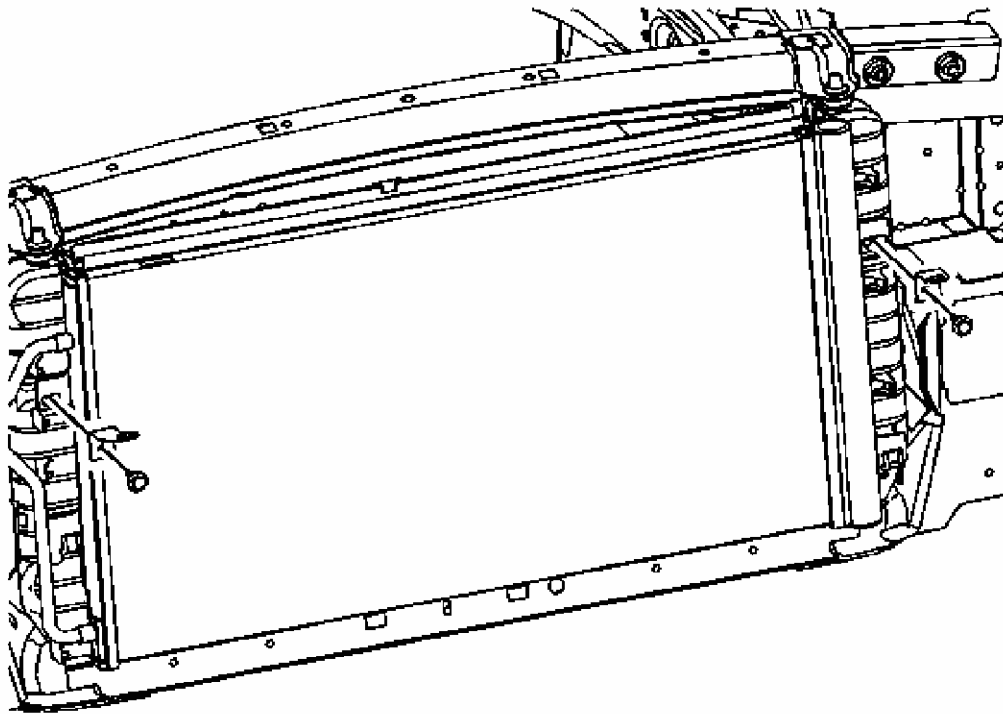
1. Install the radiator to the vehicle.



**Fig. 156: Locating Condenser Lower Attachment Points**  
**Courtesy of GENERAL MOTORS CORP.**

**IMPORTANT:** Care should be taken when installing the condenser not to damage the lower attachment points of both the radiator and condenser.

2. Position the condenser, aligning the lower feet to the lower mounting features located at the front of the radiator.



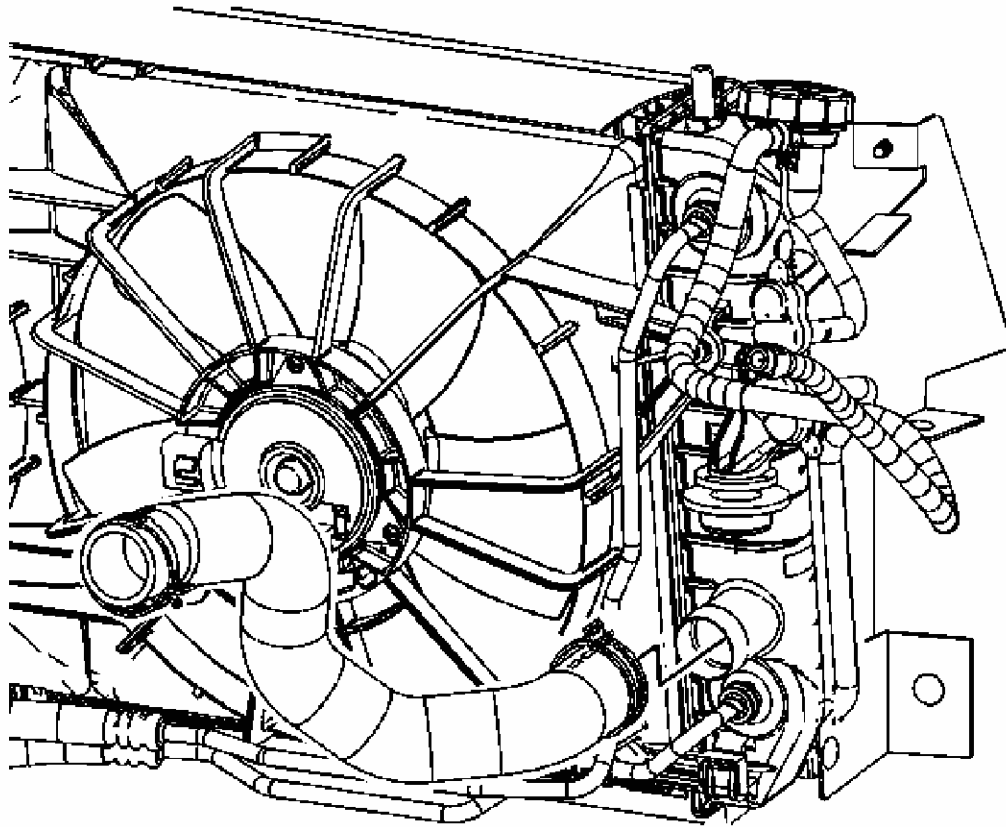
**Fig. 157: View Of Condenser & Bolts**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to Fastener Notice .

**IMPORTANT:** The bolts retaining the condenser to the radiator end tanks are a special length and should be the **ONLY** bolts used upon reinstallation. The use of longer bolts will damage the radiator end tanks.

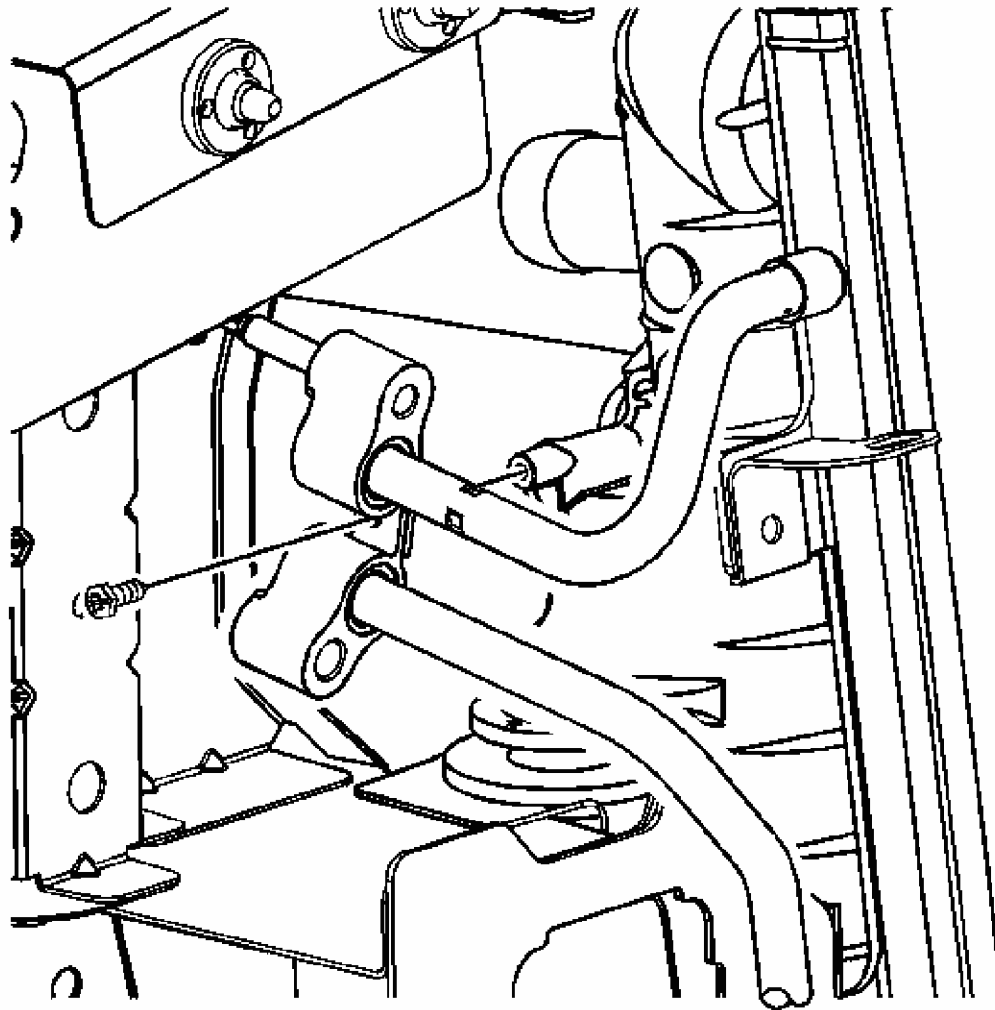
3. Install the condenser mounting bolts.

**Tighten:** Tighten the bolts to 13 N.m (115 lb in).



**Fig. 158: View Of Radiator Outlet Hose**  
**Courtesy of GENERAL MOTORS CORP.**

4. Install the radiator outlet hose to the radiator.
5. Using **J 38185** reposition the radiator outlet hose clamp.



**Fig. 159: Removing/Installing Condenser Lines**  
**Courtesy of GENERAL MOTORS CORP.**

6. Install the condenser line to radiator retaining bolt.
7. Install the cooling fans. Refer to **Engine Cooling Fan Replacement**.
8. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac-N-Fill)**.

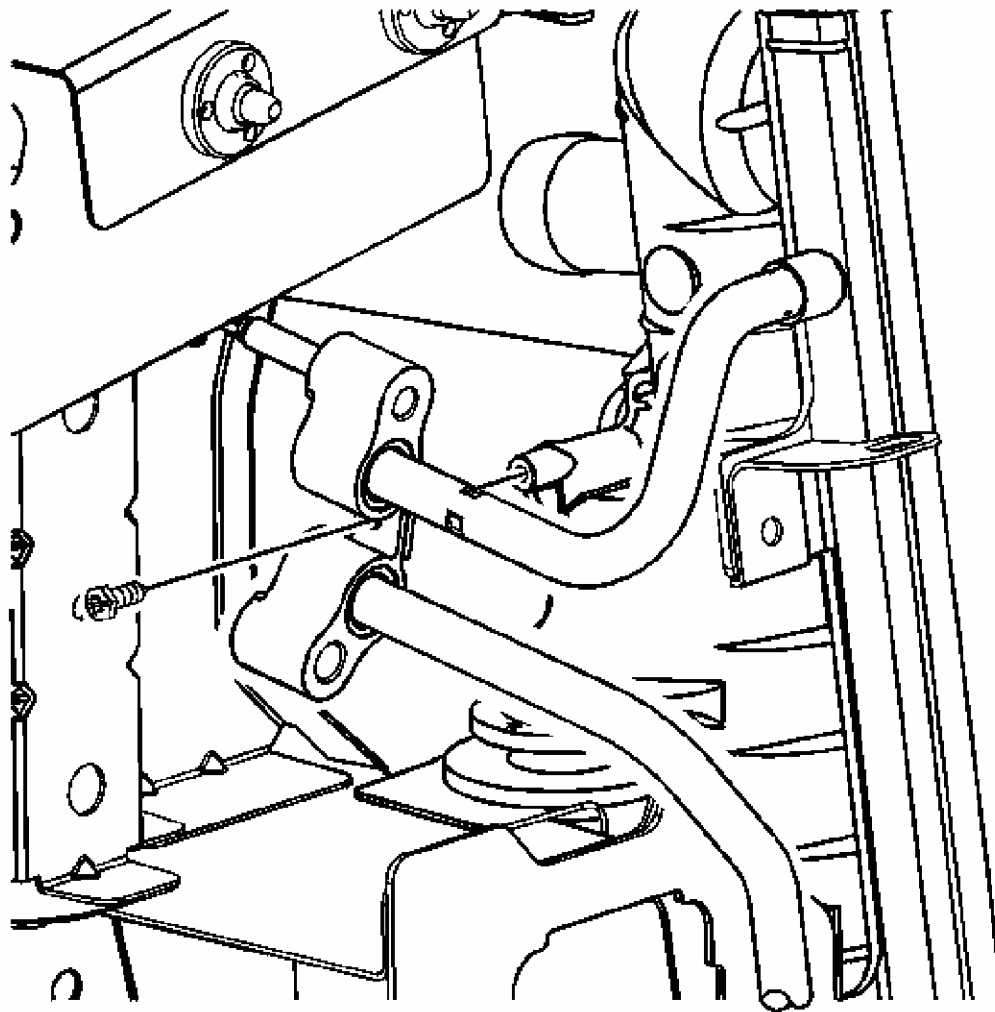
#### **RADIATOR REPLACEMENT (LD8)**

##### **Tools Required**

**J 38185** Hose Clamp Pliers

**Removal Procedure**

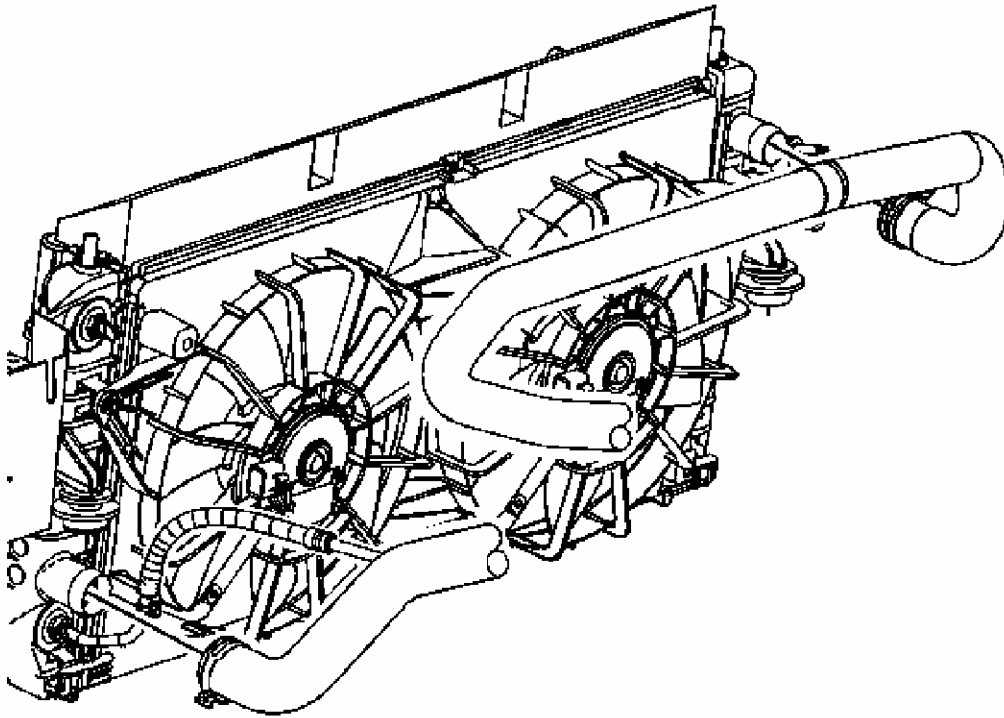
1. Partially drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac-N-Fill)**.
2. Remove the cooling fan shroud assembly. Refer to **Fan Shroud Replacement (L26)** or **Fan Shroud Replacement (LD8)**.



**Fig. 160: Removing/Installing Condenser Lines**  
**Courtesy of GENERAL MOTORS CORP.**

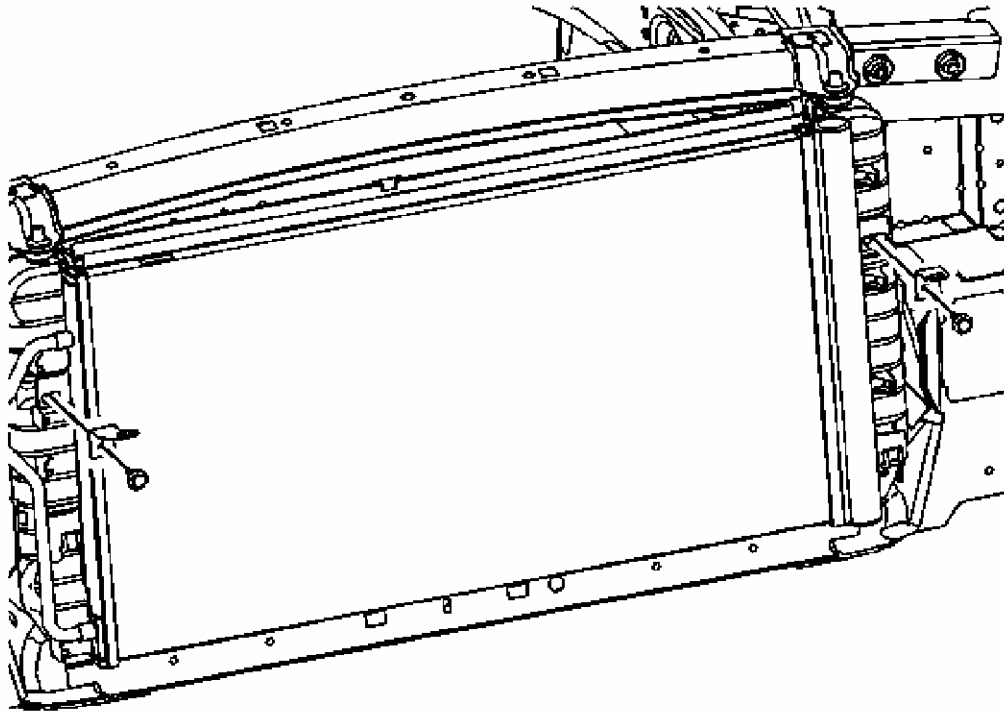
3. Remove the condenser line to radiator retaining bolt.





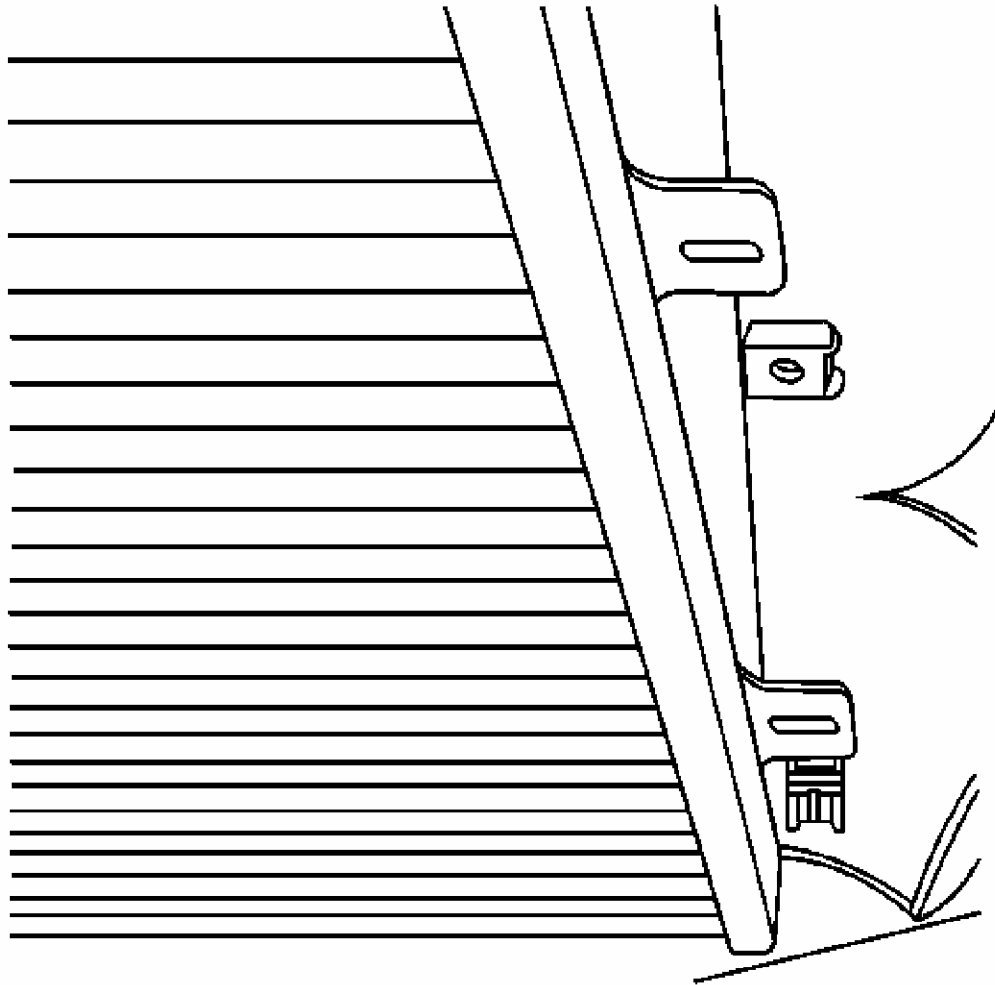
**Fig. 161: View Of Radiator Inlet & Outlet Hoses**  
**Courtesy of GENERAL MOTORS CORP.**

4. Using **J 38185** reposition the hose clamps from the radiator outlet hose.
5. Remove the radiator outlet hose from the radiator.



**Fig. 162: View Of Condenser & Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

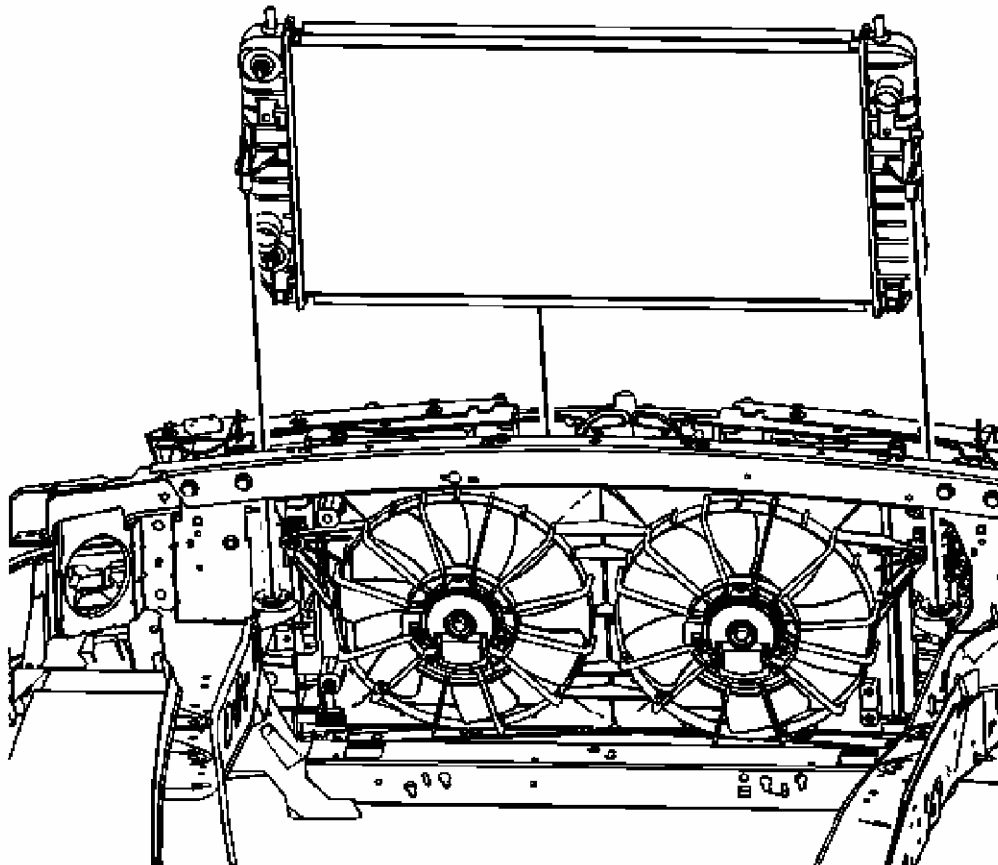
6. Remove the condenser mounting bolts.



**Fig. 163: Locating Condenser Lower Attachment Points**  
**Courtesy of GENERAL MOTORS CORP.**

**IMPORTANT:** Care should be taken when removing the condenser not to damage the lower attachment points of both the radiator and condenser.

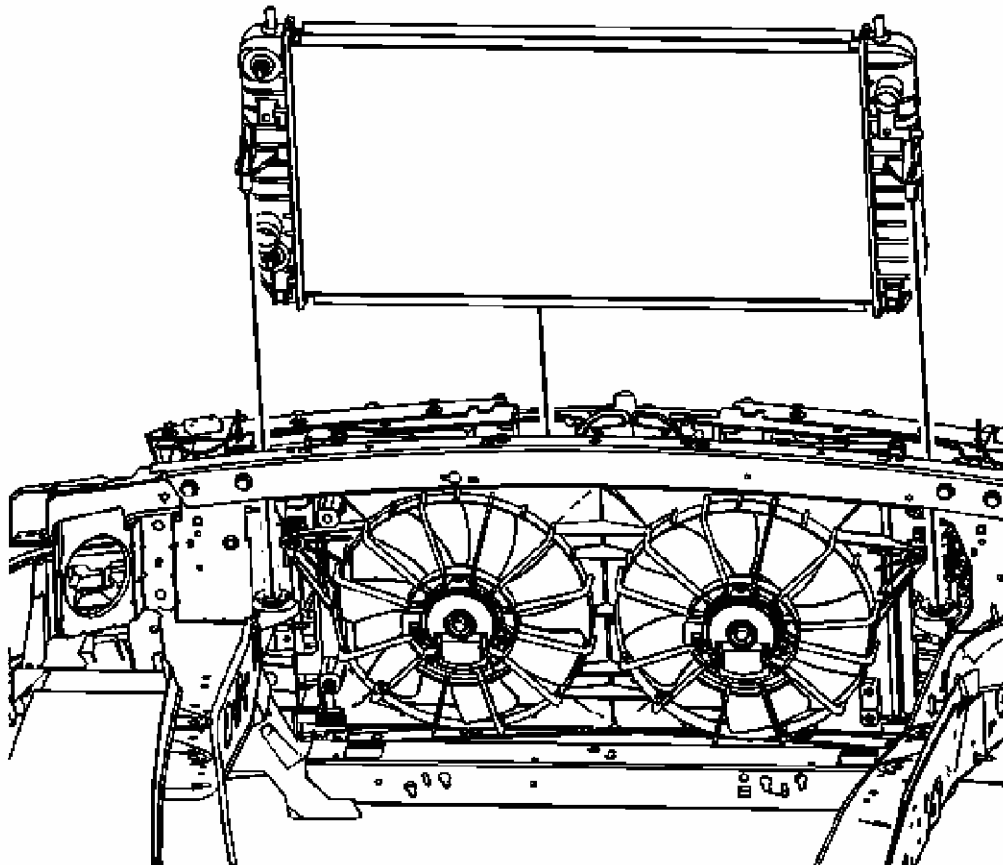
7. Lift the condenser upward slightly in order to release the lower feet from the lower mounting features located at the front of the radiator.



**Fig. 164: Removing/Installing Radiator**  
**Courtesy of GENERAL MOTORS CORP.**

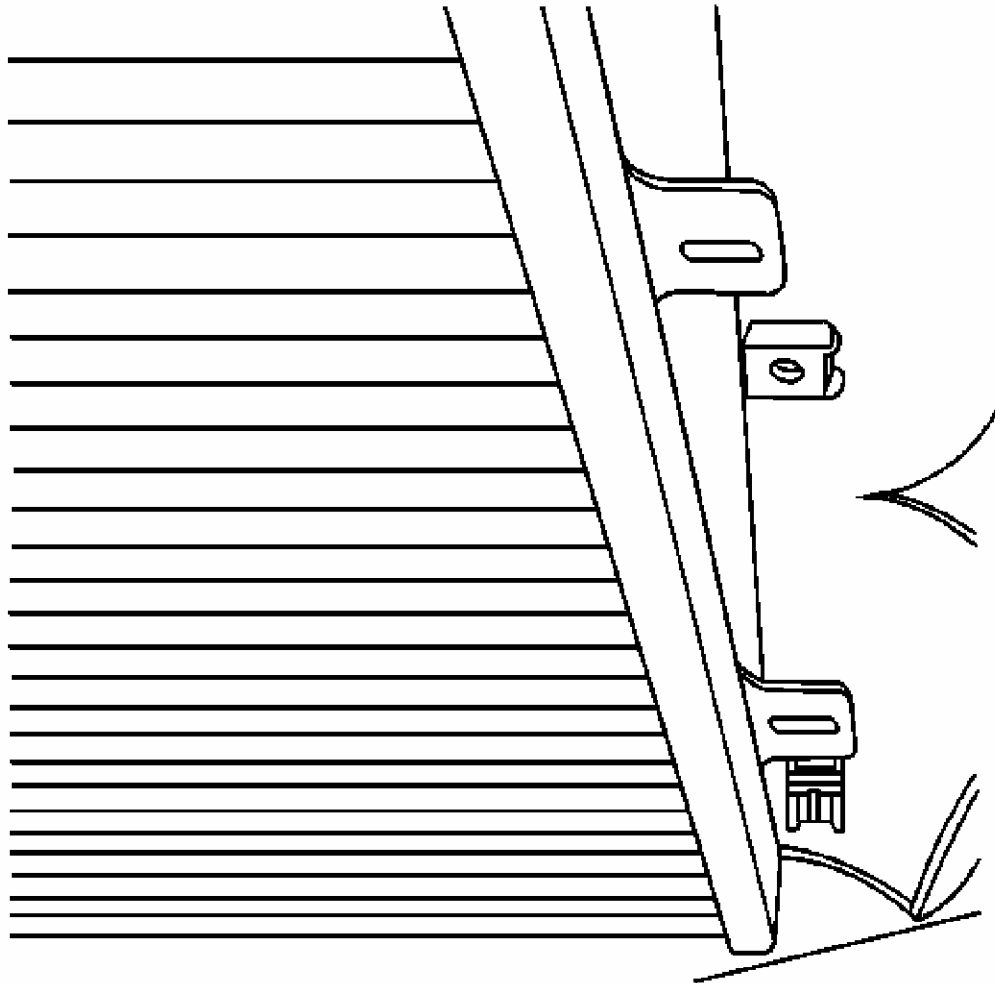
8. Lift the radiator up and out the vehicle.

**Installation Procedure**



**Fig. 165: Removing/Installing Radiator**  
**Courtesy of GENERAL MOTORS CORP.**

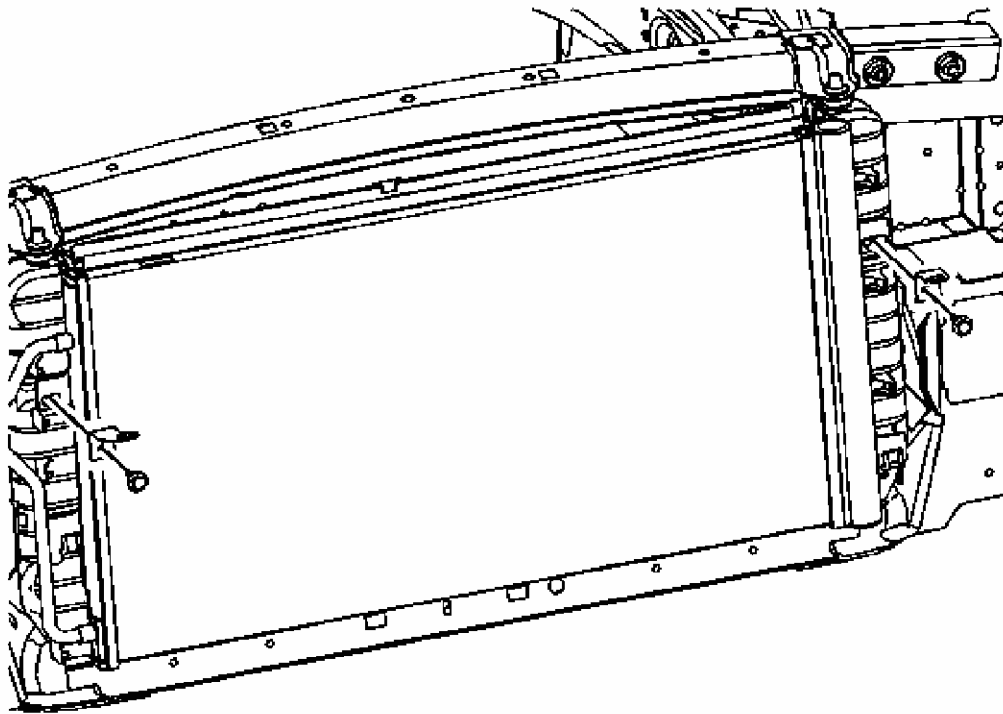
1. Install the radiator to the vehicle.



**Fig. 166: Locating Condenser Lower Attachment Points**  
**Courtesy of GENERAL MOTORS CORP.**

**IMPORTANT:** Care should be taken when installing the condenser not to damage the lower attachment points of both the radiator and condenser.

2. Position the condenser, aligning the lower feet to the lower mounting features located at the front of the radiator.



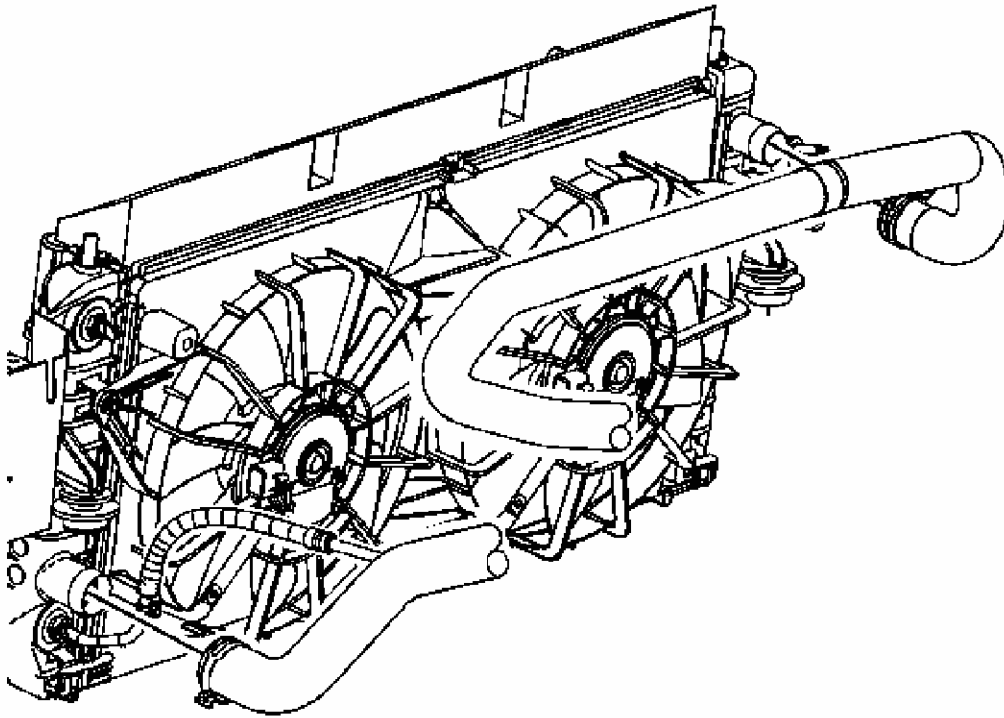
**Fig. 167: View Of Condenser & Bolts**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to Fastener Notice .

**IMPORTANT:** The bolts retaining the condenser to the radiator end tanks are a special length and should be the **ONLY** bolts used upon reinstallation. The use of longer bolts will damage the radiator end tanks.

3. Install the condenser mounting bolts.

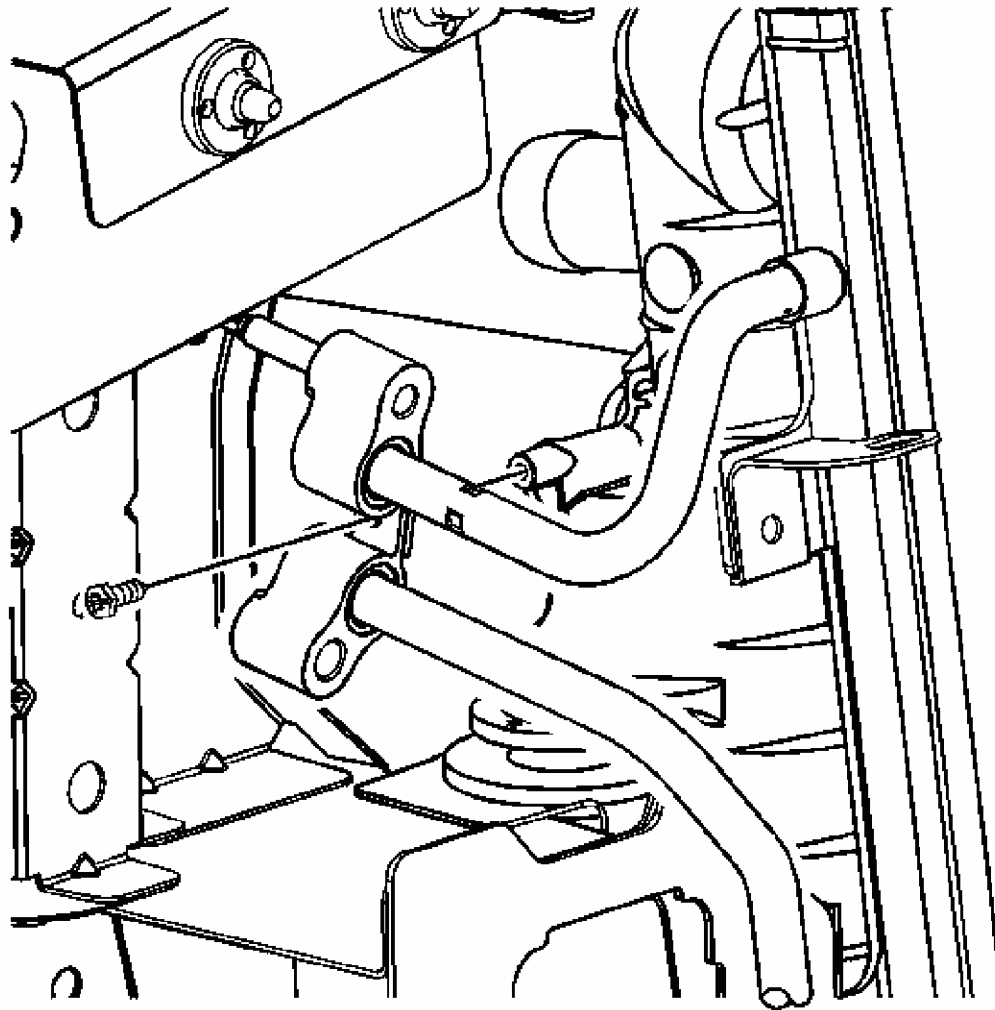
**Tighten:** Tighten the bolts to 13 N.m (115 lb in).



**Fig. 168: View Of Radiator Inlet & Outlet Hoses**  
**Courtesy of GENERAL MOTORS CORP.**

4. Install the radiator outlet hose to the radiator.
5. Using **J 38185** reposition the radiator outlet hose clamp.

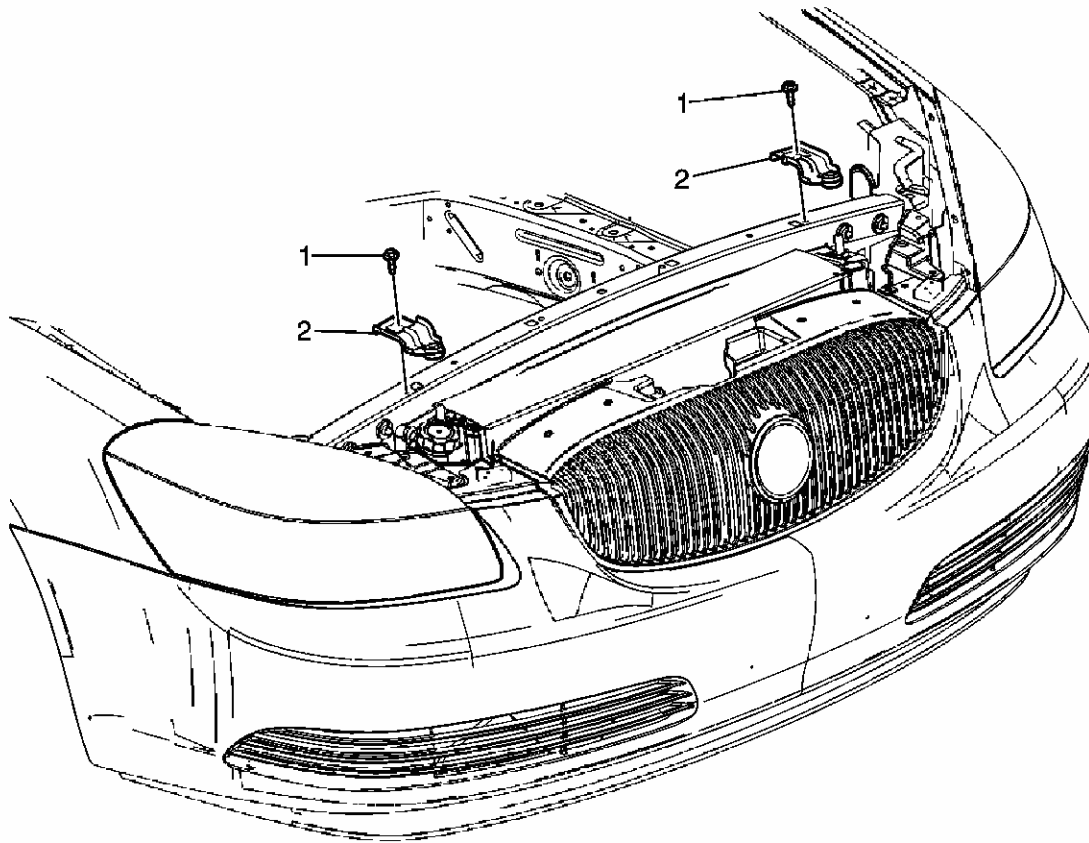




**Fig. 169: Removing/Installing Condenser Lines**  
**Courtesy of GENERAL MOTORS CORP.**

6. Install the condenser line to radiator retaining bolt.
7. Install the cooling fans. Refer to **Engine Cooling Fan Replacement**.
8. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac-N-Fill)**.

#### **RADIATOR SUPPORT BRACKET REPLACEMENT**



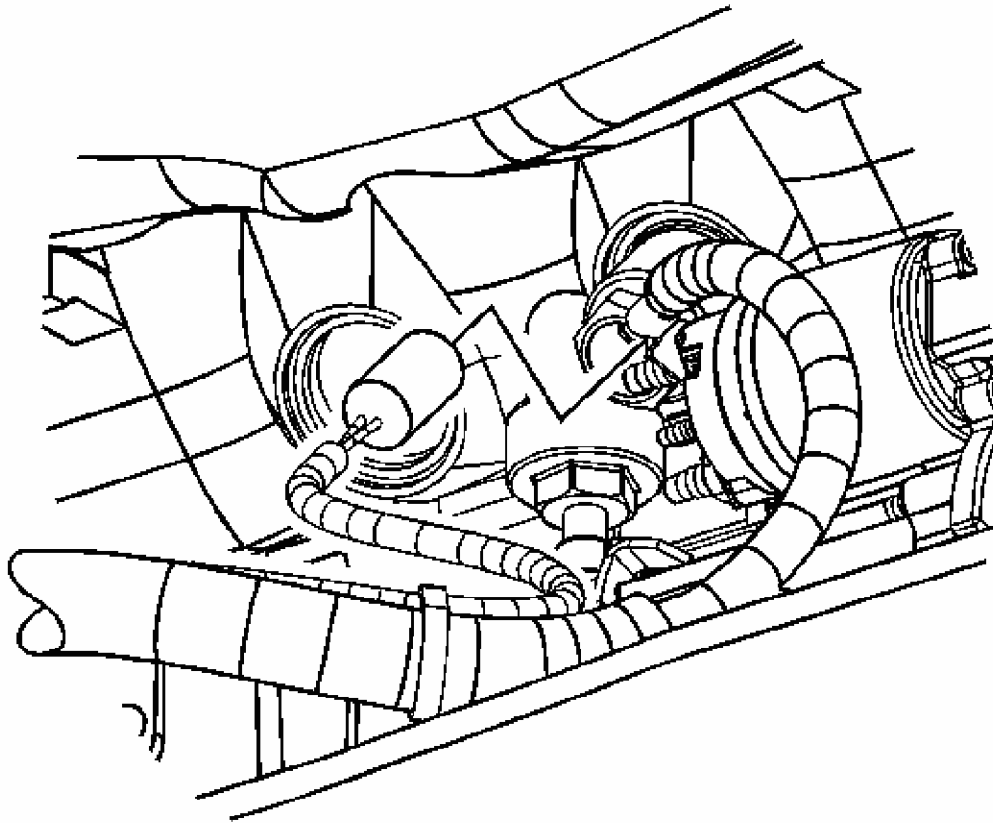
**Fig. 170: Locating Radiator Support Bracket**  
 Courtesy of GENERAL MOTORS CORP.

### Radiator Support Bracket Replacement

Callout	Component Name
<b>NOTE:</b> Refer to <u>Fastener Notice</u> .	
<b>Fastener Tightening Specifications:</b> Refer to <u>Fastener Tightening Specifications</u> . <b>Preliminary Procedure:</b> Remove the front compartment sight shield. Refer to <u>Front Compartment Sight Shields Replacement</u> .	
1	Upper Radiator Bracket Bolt <b>Tighten:</b> 25 N.m (18 lb ft)
2	Upper Radiator Bracket

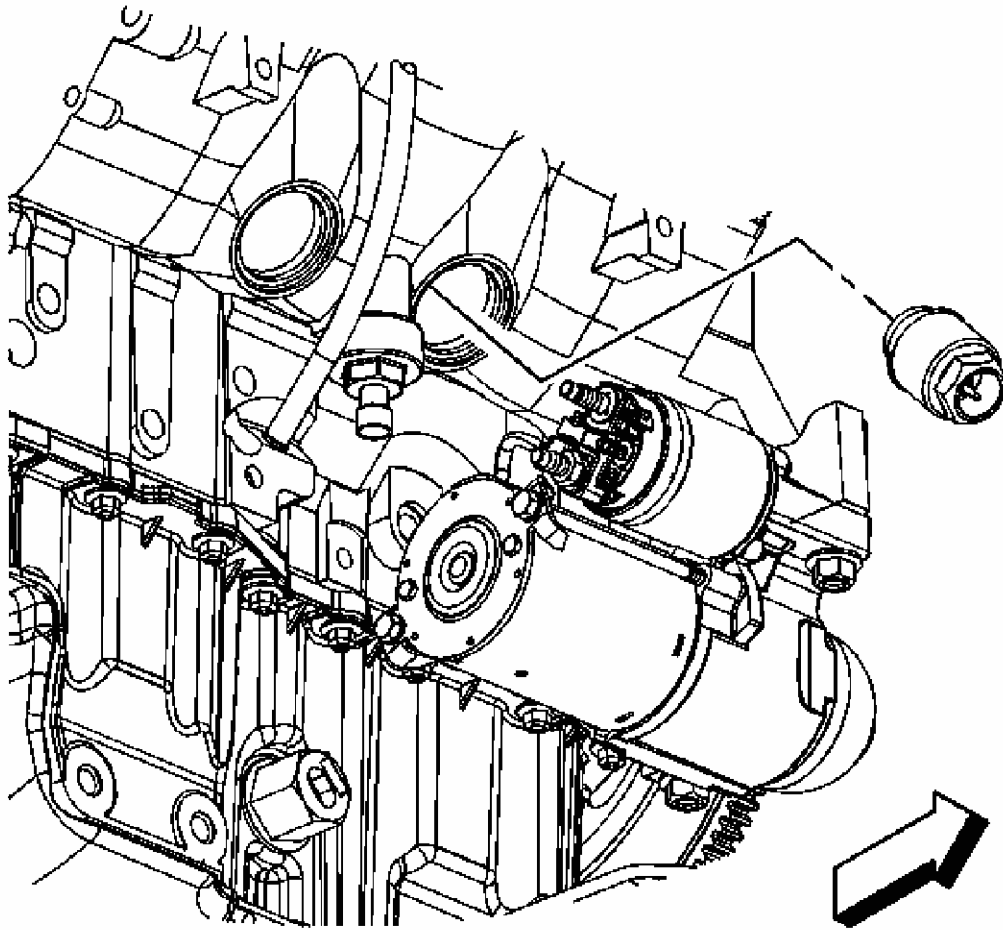
### COOLANT HEATER REPLACEMENT (L26)

#### Removal Procedure



**Fig. 171: View Of Coolant Heater Cord & Connector**  
**Courtesy of GENERAL MOTORS CORP.**

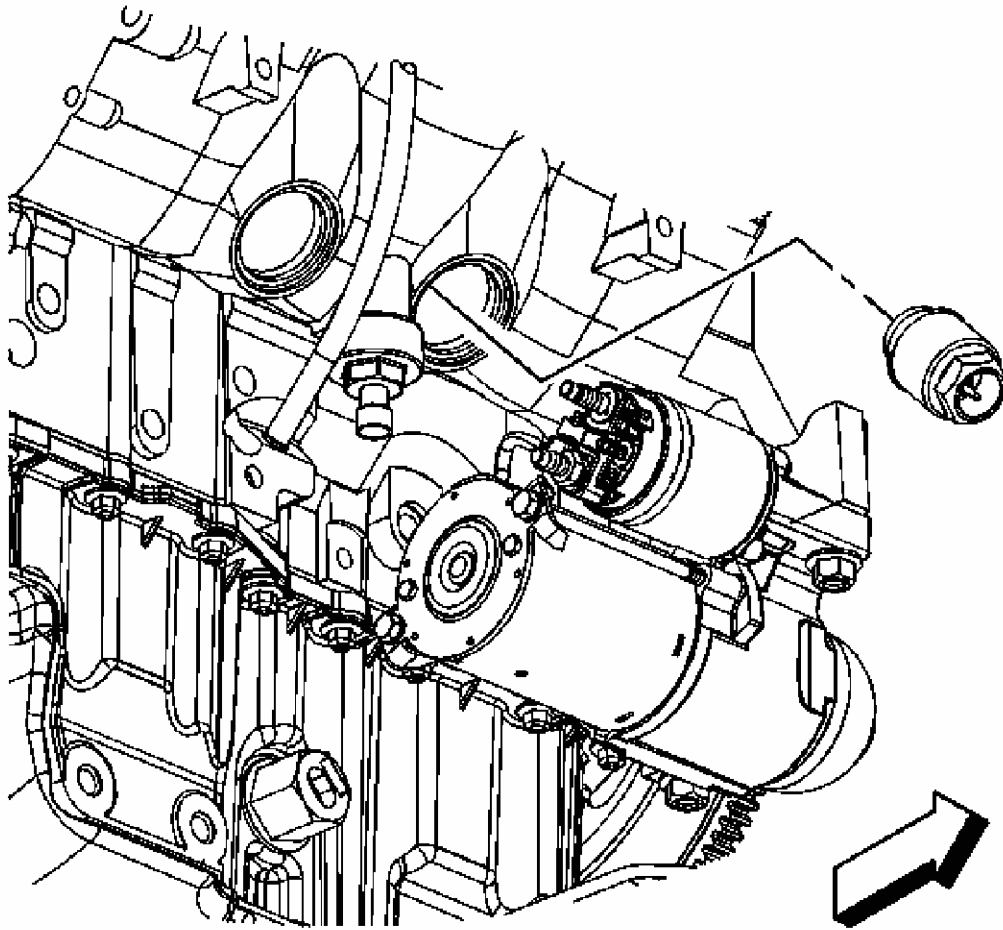
1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac-N-Fill)**.
2. Disconnect the coolant heater cord from the coolant heater.



**Fig. 172: Locating Coolant Heater**  
**Courtesy of GENERAL MOTORS CORP.**

3. Remove the coolant heater.
4. Remove and clean any burrs, compound, paint or rough spots from the core plug hole.

**Installation Procedure**



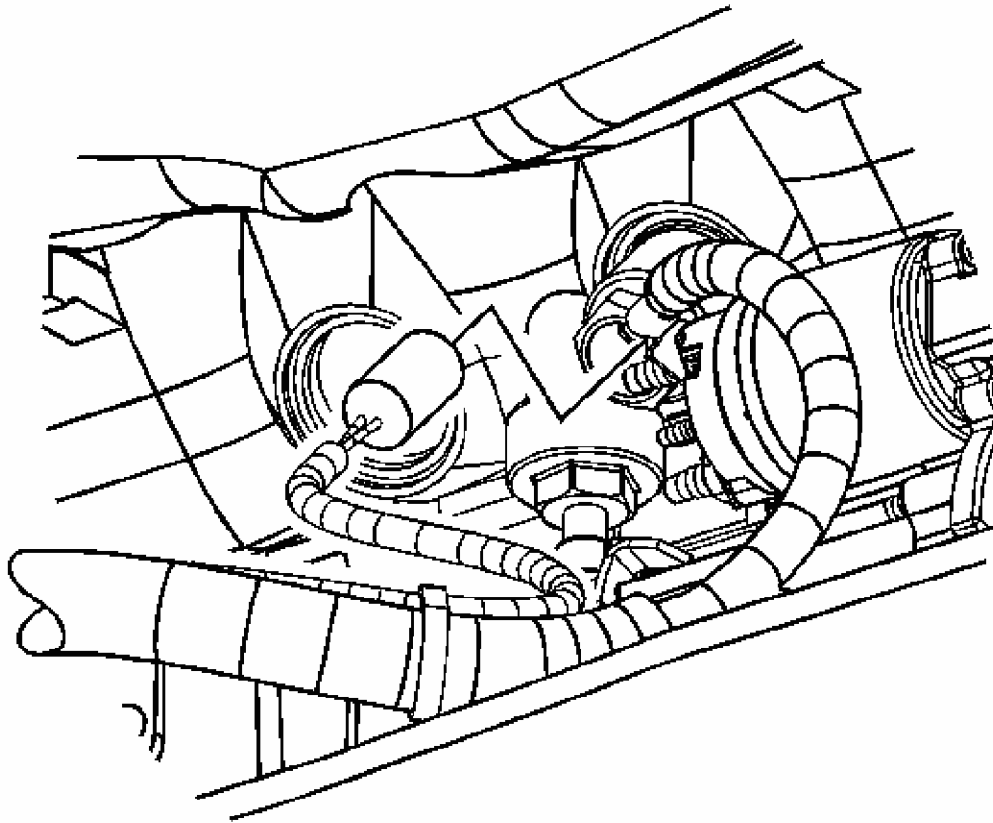
**Fig. 173: Locating Coolant Heater**  
**Courtesy of GENERAL MOTORS CORP.**

1. Apply sealant GM P/N 12346004, (Canadian P/N 10953480) or equivalent to the coolant heater.

**NOTE:** Refer to Fastener Notice .

2. Install the coolant heater.

**Tighten:** Tighten the coolant heater to 50 N.m (37 lb ft).



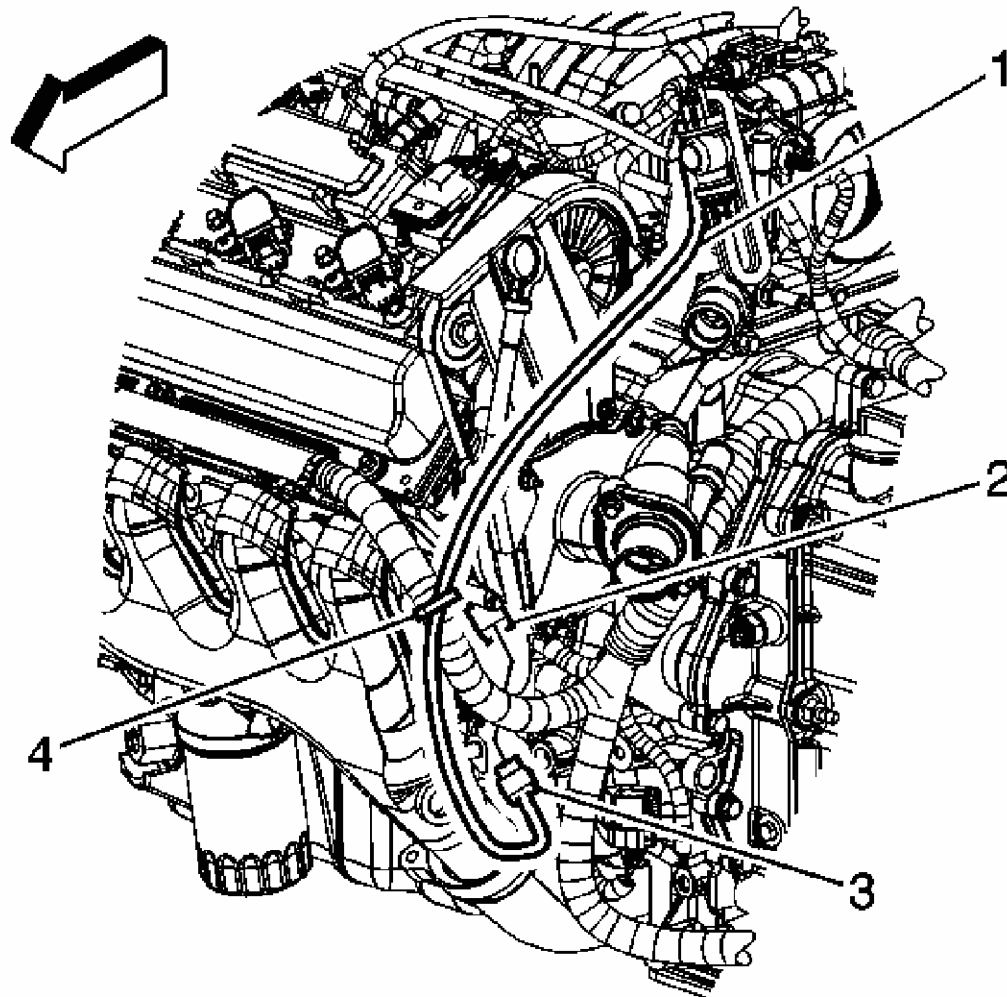
**Fig. 174: View Of Coolant Heater Cord & Connector**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** The heater cord must not touch the engine, hot pipes, manifold or any moving parts. Route the cord to the left front of the engine compartment securing with tie straps as necessary to prevent damage.

3. Connect the coolant heater cord to the coolant heater.
4. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac-N-Fill)**.

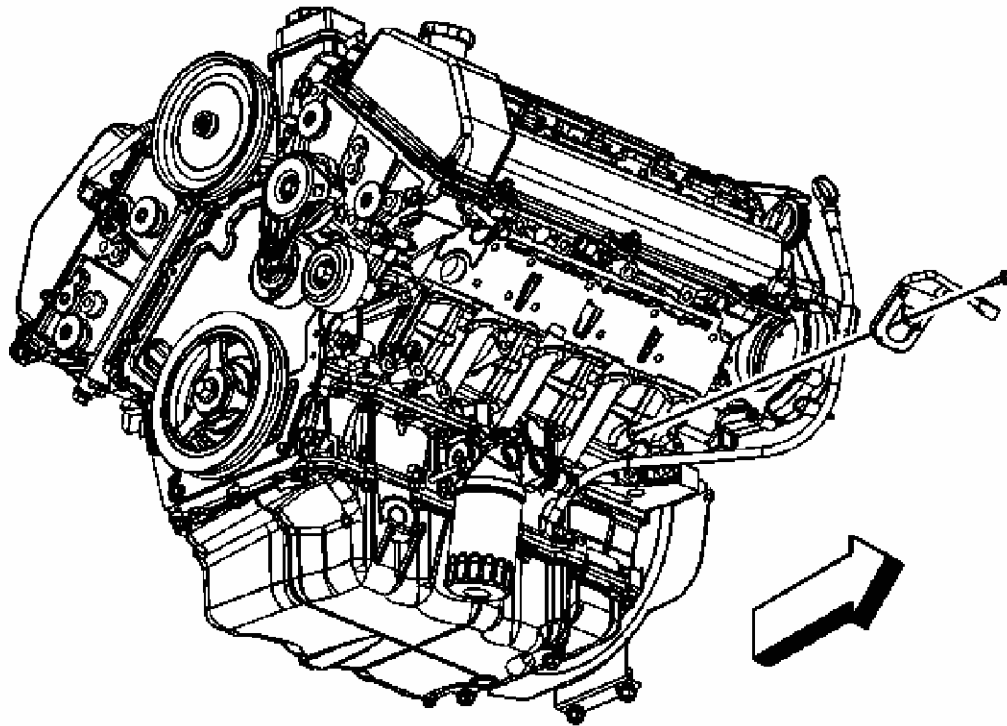
#### **ENGINE COOLANT HEATER REPLACEMENT - LEFT SIDE (RPO LD8)**

##### **Removal Procedure**



**Fig. 175: Locating Coolant Heater Cord Electrical Connector**  
**Courtesy of GENERAL MOTORS CORP.**

1. Remove the front air deflector. Refer to **Front Air Deflector Replacement** .
2. Disconnect the coolant heater cord electrical connector (3) from the coolant heater electrical connector (2).

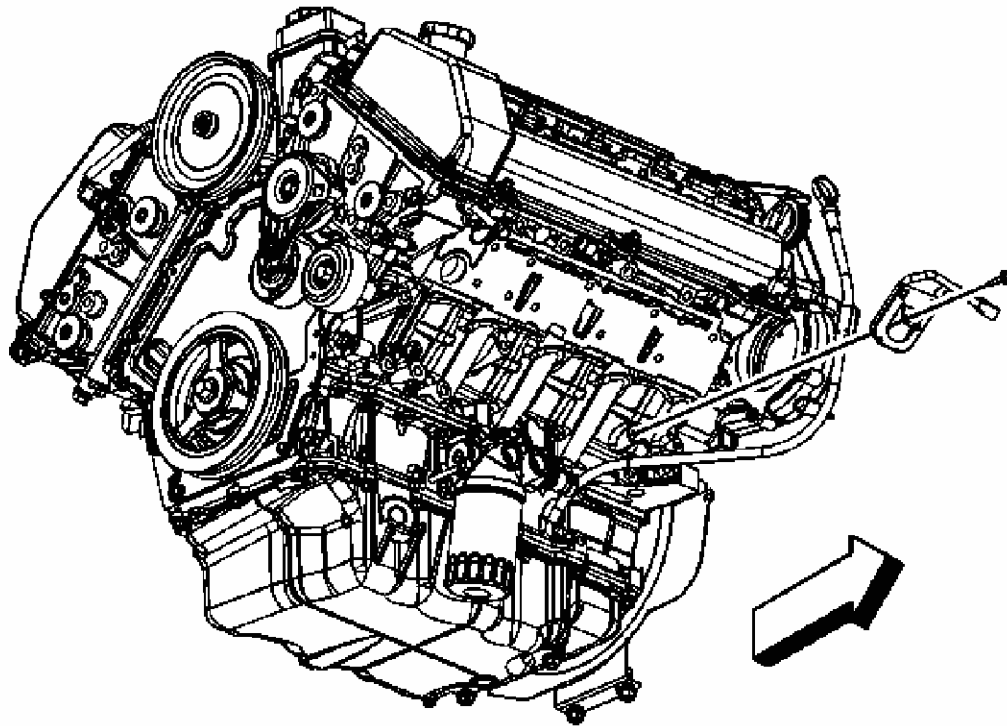


**Fig. 176: Locating Coolant Heater & Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

3. Remove the coolant heater bolt.
4. Remove the coolant heater.

**Installation Procedure**





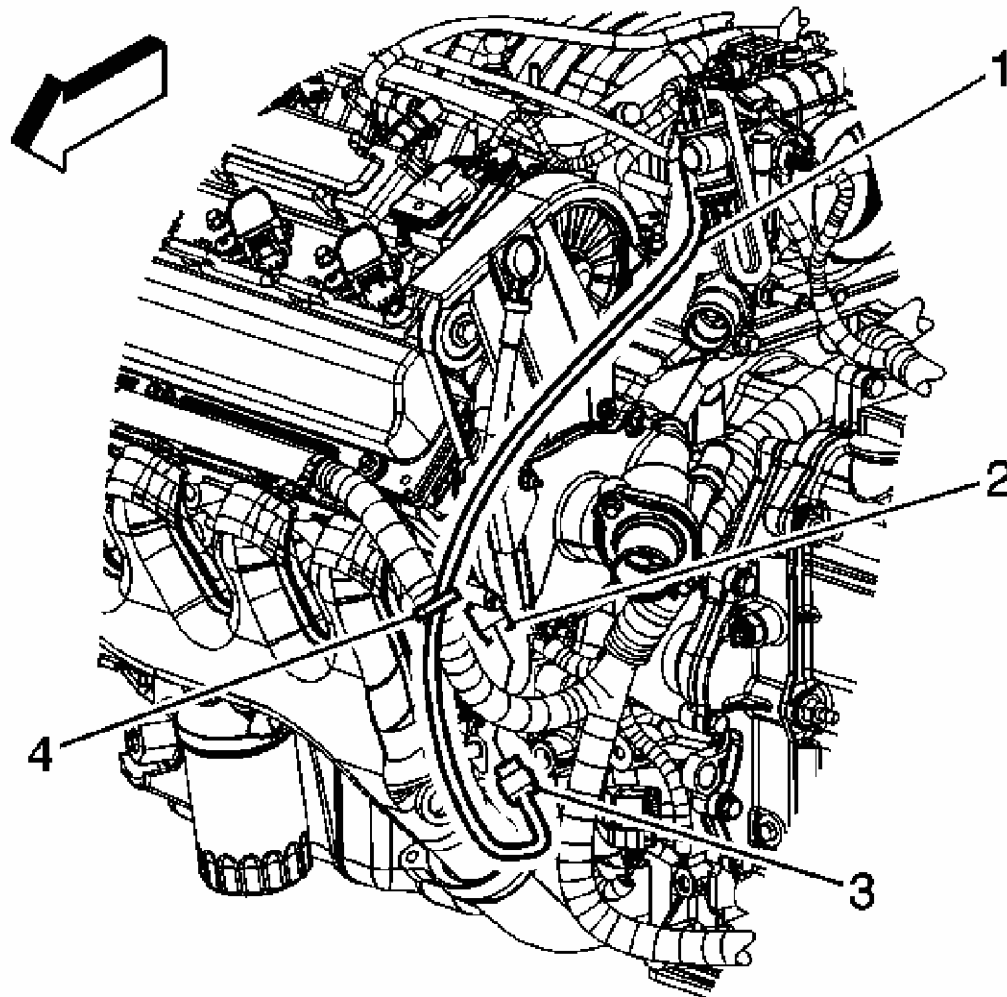
**Fig. 177: Locating Coolant Heater & Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

1. Position the coolant heater to the engine block.

**NOTE:** Refer to Fastener Notice .

2. Install the coolant heater bolt.

**Tighten:** Tighten the bolt to 10 N.m (89 lb in).

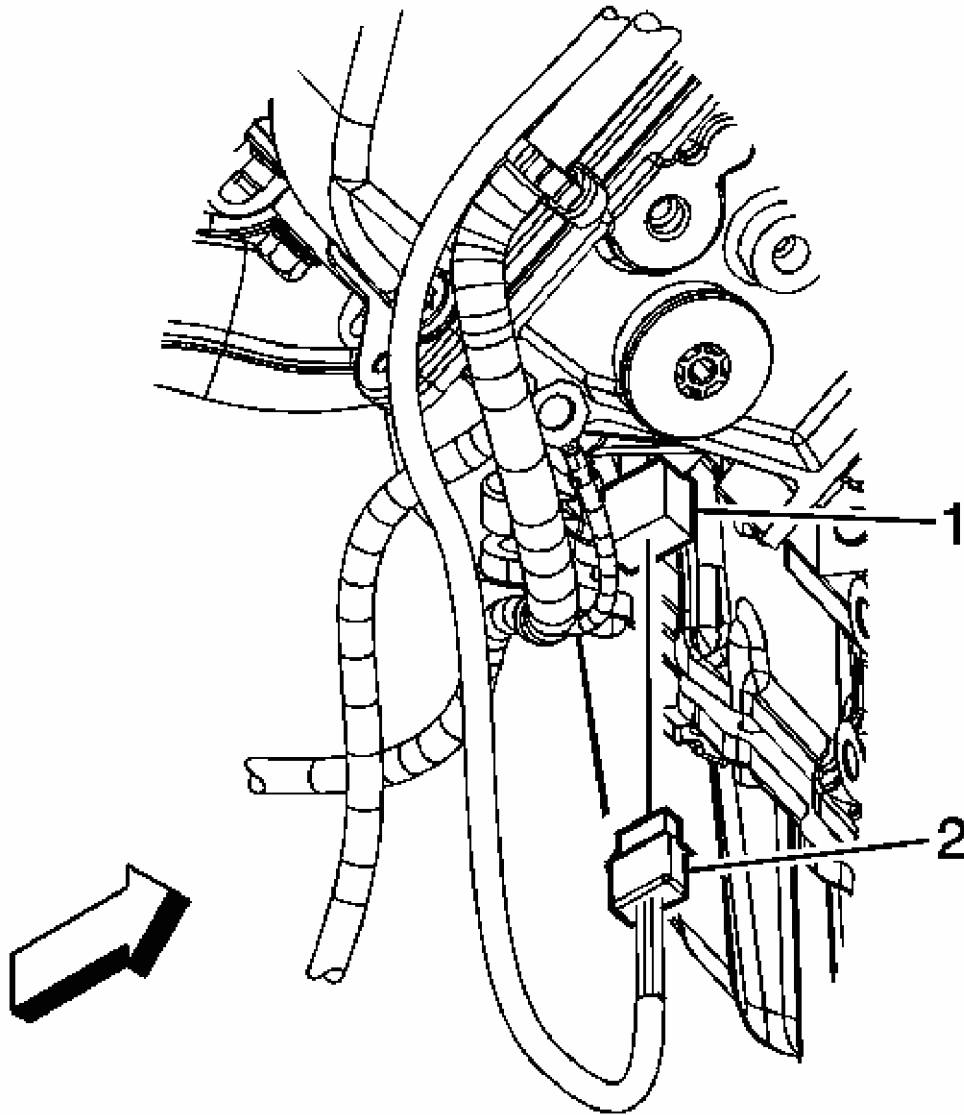


**Fig. 178: Locating Coolant Heater Cord Electrical Connector**  
Courtesy of GENERAL MOTORS CORP.

3. Connect the coolant heater cord electrical connector (3) to the coolant heater electrical connector (2).
4. Remove the front air deflector. Refer to **Front Air Deflector Replacement** .

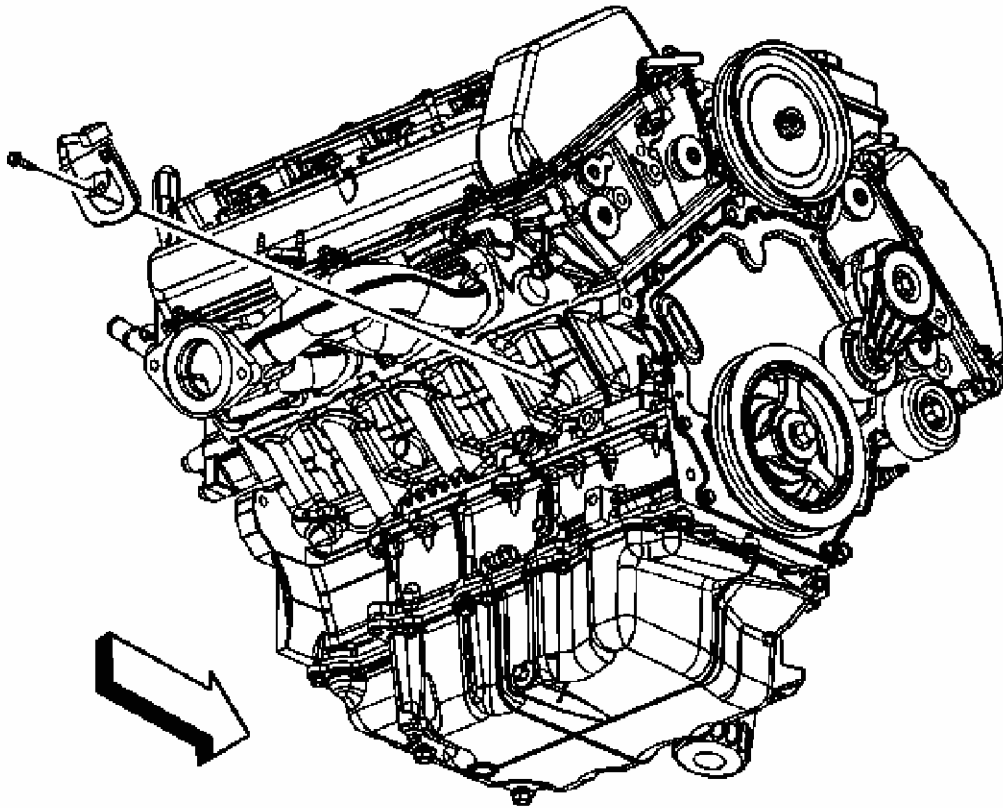
#### **ENGINE COOLANT HEATER REPLACEMENT - RIGHT SIDE (RPO LD8)**

##### **Removal Procedure**



**Fig. 179: Identifying Right Coolant Heater Electrical Connector**  
**Courtesy of GENERAL MOTORS CORP.**

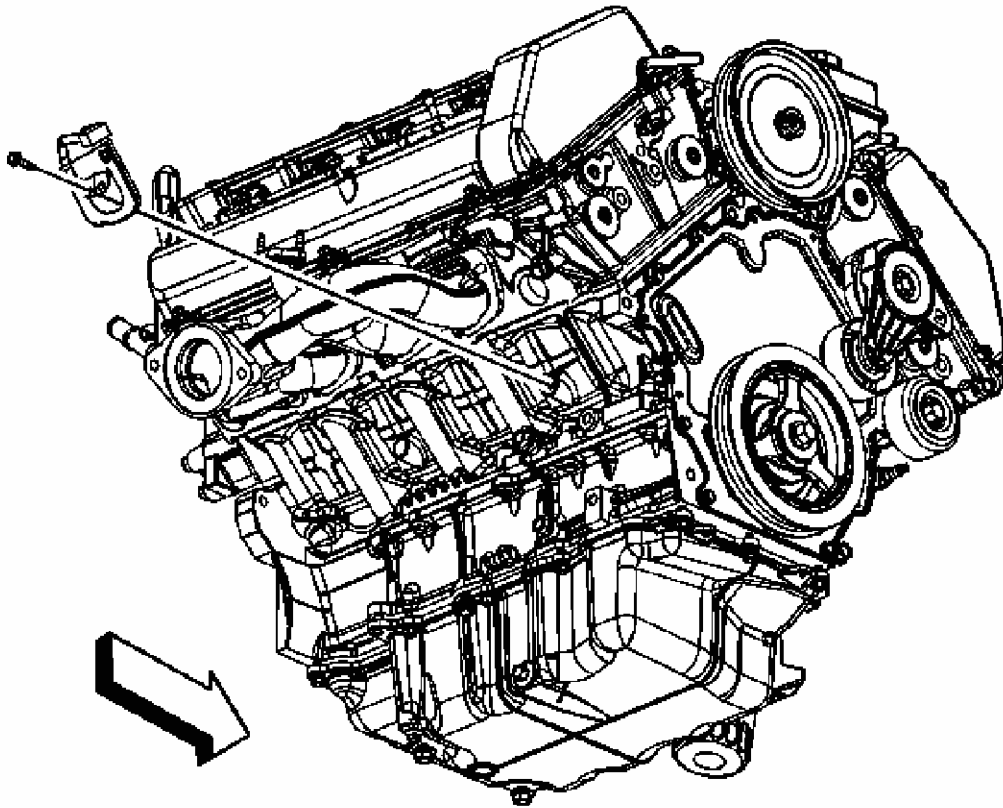
1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Disconnect the coolant heater cord electrical connector (2) from the coolant heater electrical connector (1).



**Fig. 180: Identifying Coolant Heater & Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

3. Remove the coolant heater bolt.
4. Remove the coolant heater.

**Installation Procedure**



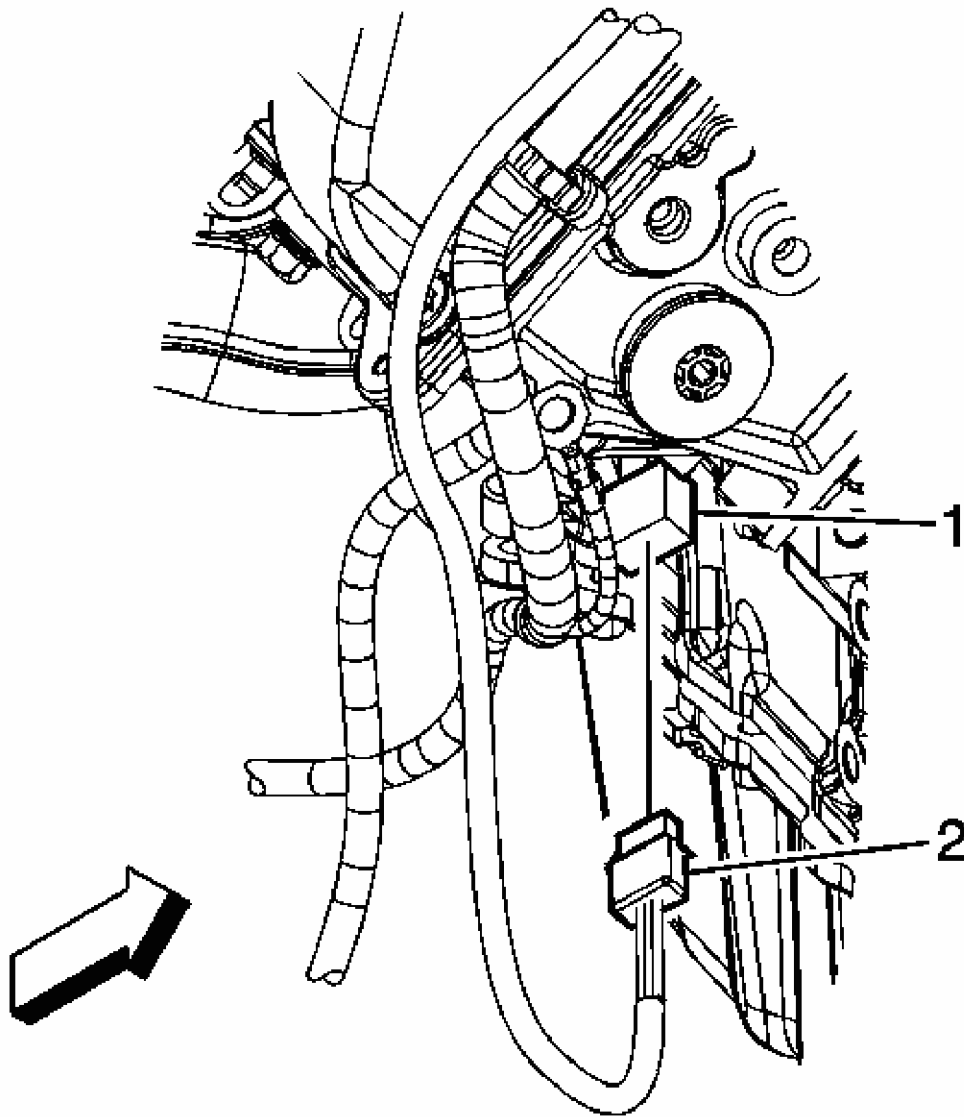
**Fig. 181: Identifying Coolant Heater & Bolt**  
Courtesy of GENERAL MOTORS CORP.

1. Position the coolant heater to the engine block.

**NOTE:** Refer to Fastener Notice .

2. Install the coolant heater bolt.

**Tighten:** Tighten the bolt to 10 N.m (89 lb in).

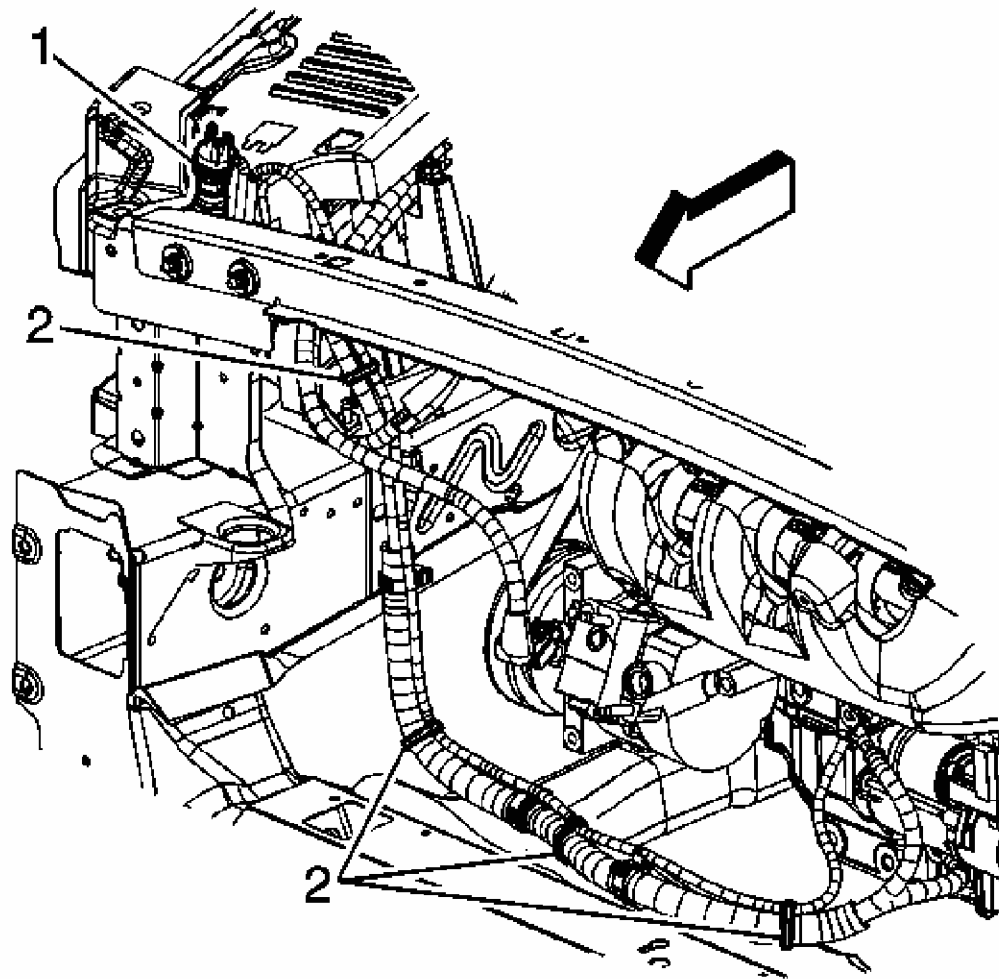


**Fig. 182: Identifying Right Coolant Heater Electrical Connector**  
**Courtesy of GENERAL MOTORS CORP.**

3. Connect the coolant heater cord electrical connector (2) to the coolant heater electrical connector (1).
4. Lower the vehicle.

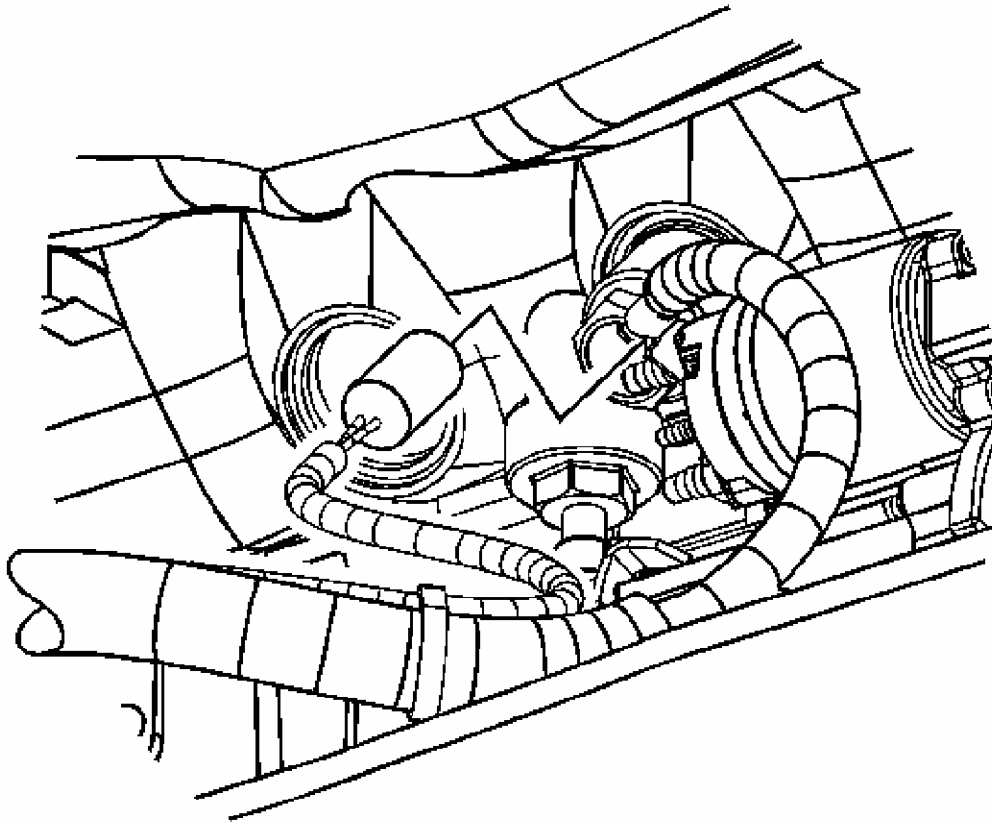
#### **COOLANT HEATER CORD REPLACEMENT (RPO L26)**

##### **Removal Procedure**



**Fig. 183: Identifying Coolant Heater Cord (RPO L26)**  
**Courtesy of GENERAL MOTORS CORP.**

1. Remove the coolant heater cord (1) from in between the underhood electrical center and upper tie bar.
2. Cut the coolant heater cord straps (2) attaching the cord to the starter cable.

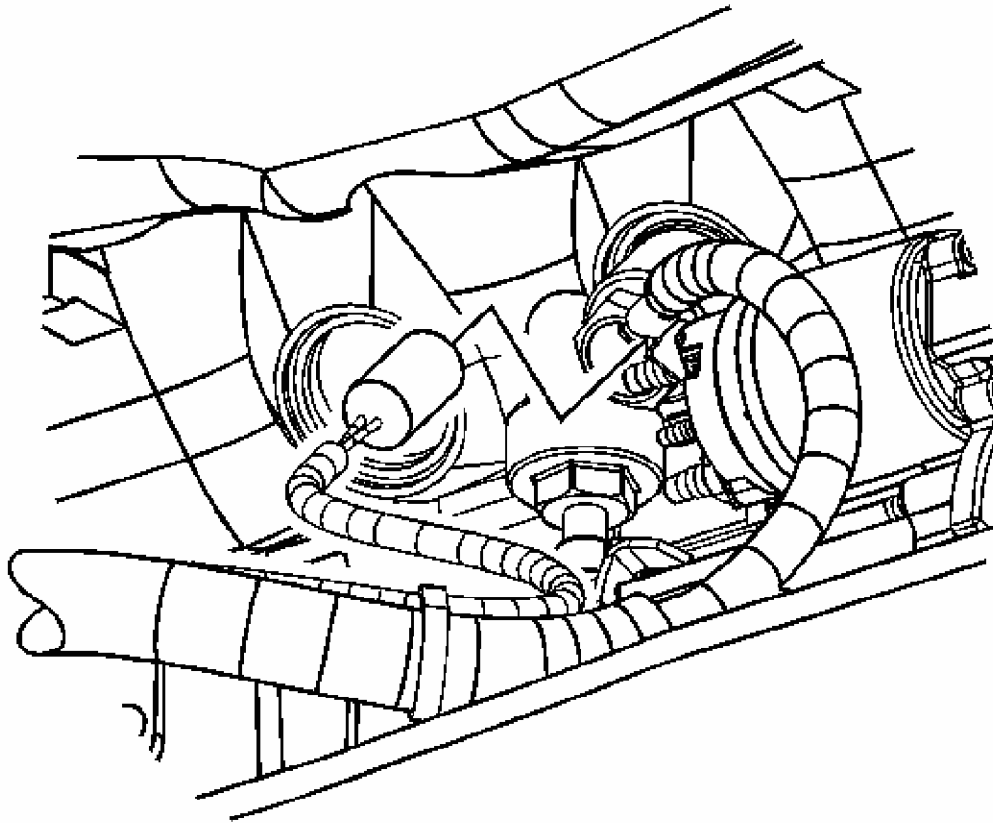


**Fig. 184: View Of Coolant Heater Cord & Connector**  
**Courtesy of GENERAL MOTORS CORP.**

3. Disconnect the coolant heater cord from the coolant heater.
4. Remove the coolant heater cord.

**Installation Procedure**

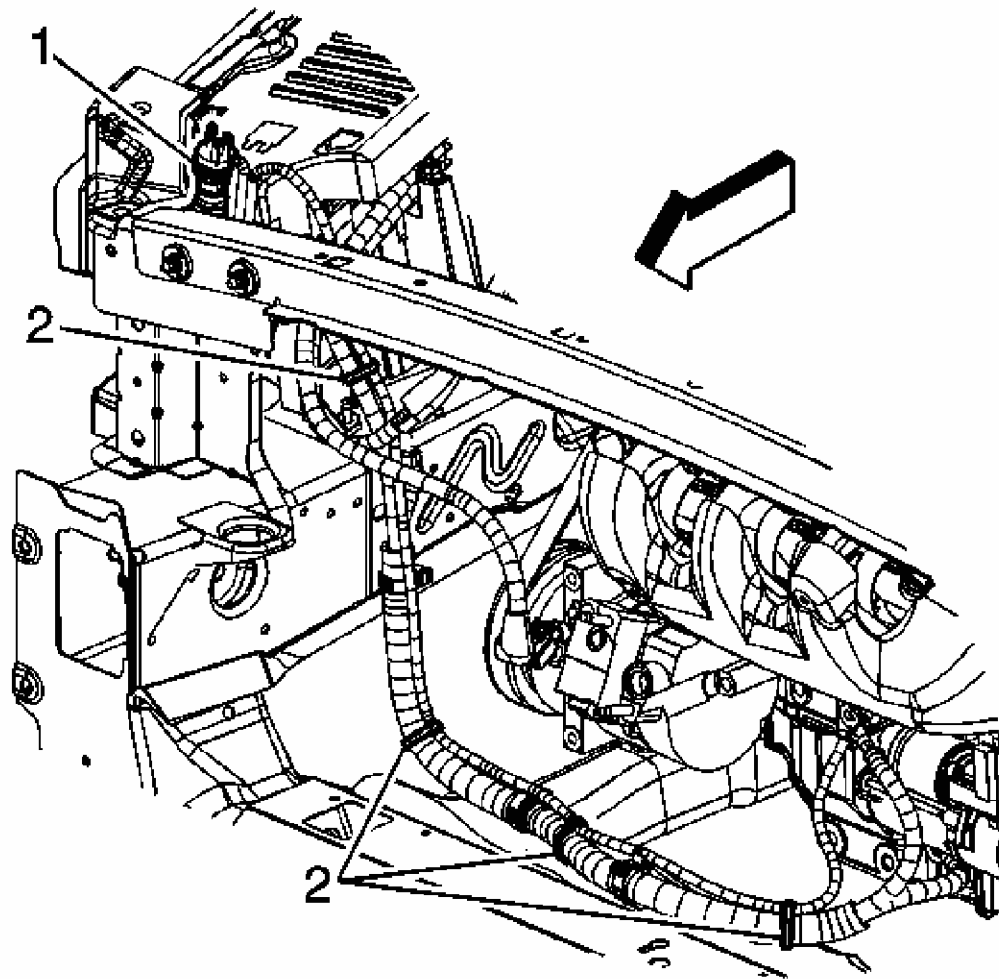




**Fig. 185: View Of Coolant Heater Cord & Connector**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** The heater cord must not touch the engine, hot pipes, manifold or any moving parts. Route the cord to the left front of the engine compartment securing with tie straps as necessary to prevent damage.

1. Install the coolant heater cord.
2. Connect the coolant heater cord to the coolant heater.

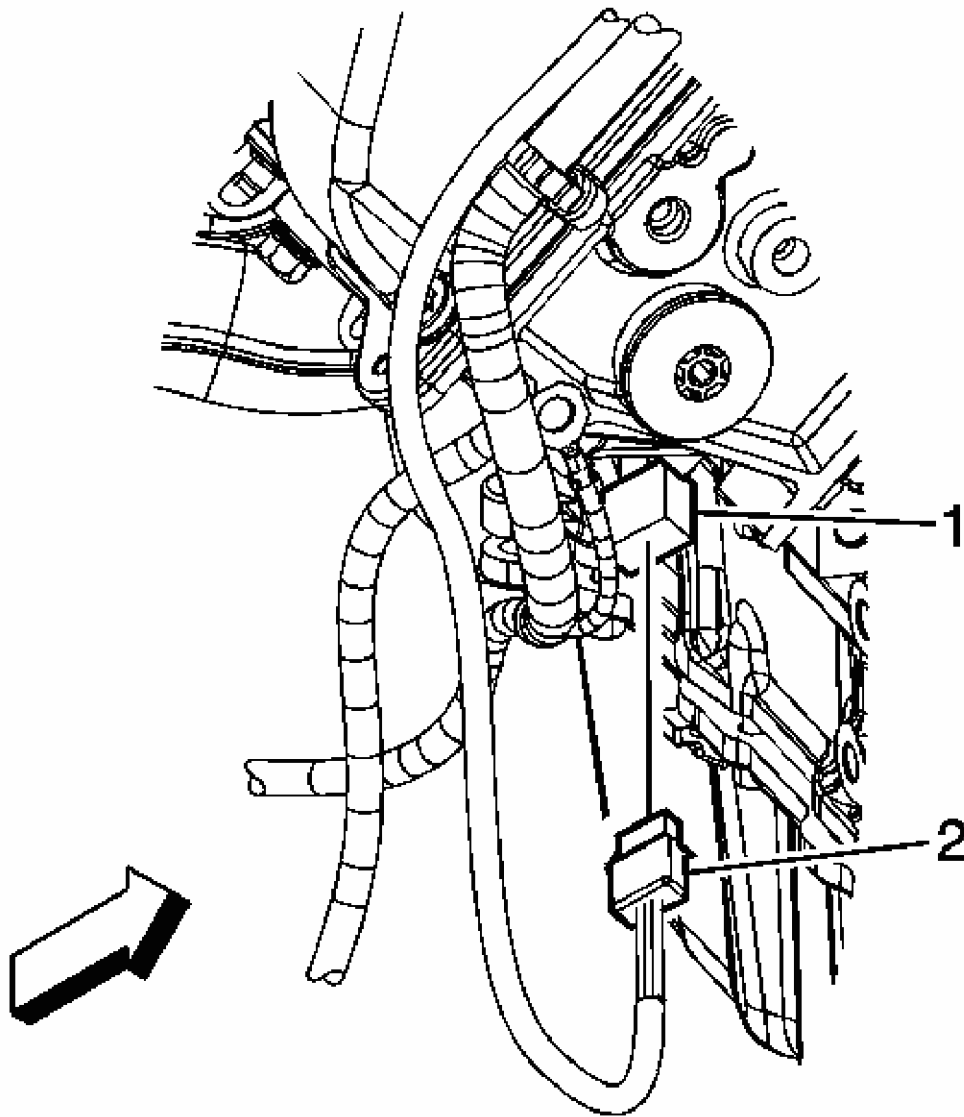


**Fig. 186: Identifying Coolant Heater Cord (RPO L26)**  
**Courtesy of GENERAL MOTORS CORP.**

3. Install NEW straps (2) securing the coolant heater cord to the starter cable.
4. Install the coolant heater cord (1) in between the underhood electrical center and upper tie bar.

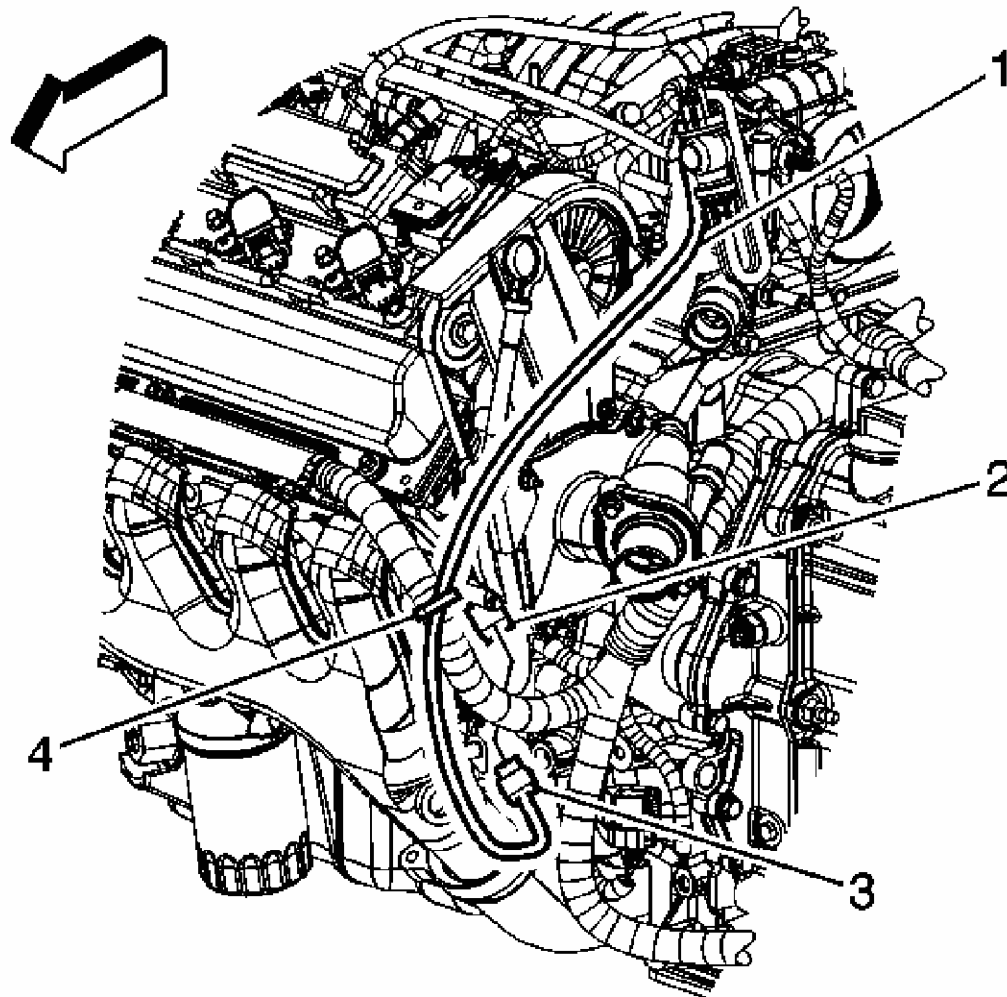
#### **COOLANT HEATER CORD REPLACEMENT (LD8)**

##### **Removal Procedure**



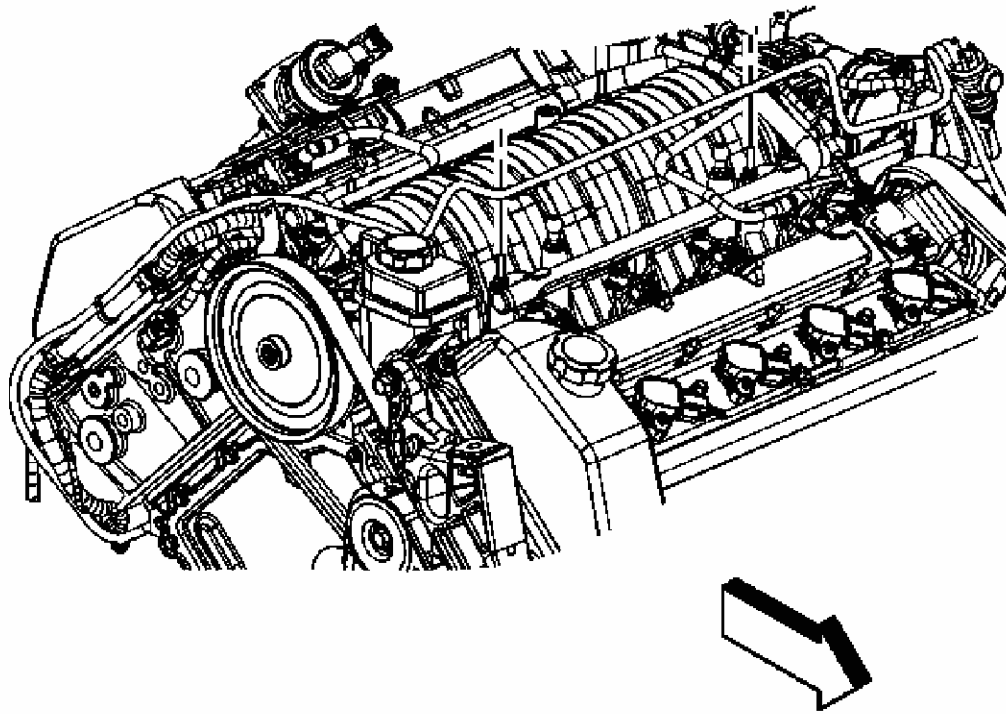
**Fig. 187: Identifying Right Coolant Heater Electrical Connector**  
**Courtesy of GENERAL MOTORS CORP.**

1. Remove the surge tank inlet hose/pipe. Refer to **Radiator Surge Tank Inlet Hose/Pipe Replacement (LD8)**.
2. Disconnect the coolant heater cord electrical connector (2) from the right coolant heater electrical connector (1).



**Fig. 188: Locating Coolant Heater Cord Electrical Connector**  
**Courtesy of GENERAL MOTORS CORP.**

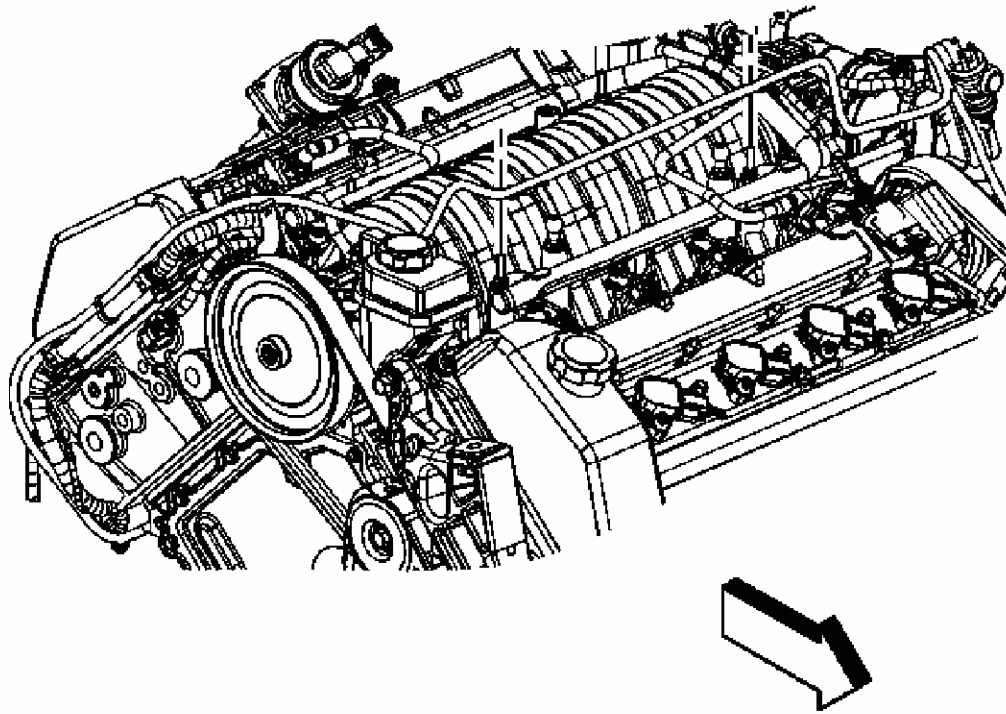
3. Disconnect the coolant heater cord electrical connector (3) from the left coolant heater electrical connector (2).
4. Cut the coolant heater cord strap (4) at the engine harness.
5. Remove the coolant heater cord clip (1) from the lift hook bracket.



**Fig. 189: Locating Coolant Heater Cord Tabs**  
**Courtesy of GENERAL MOTORS CORP.**

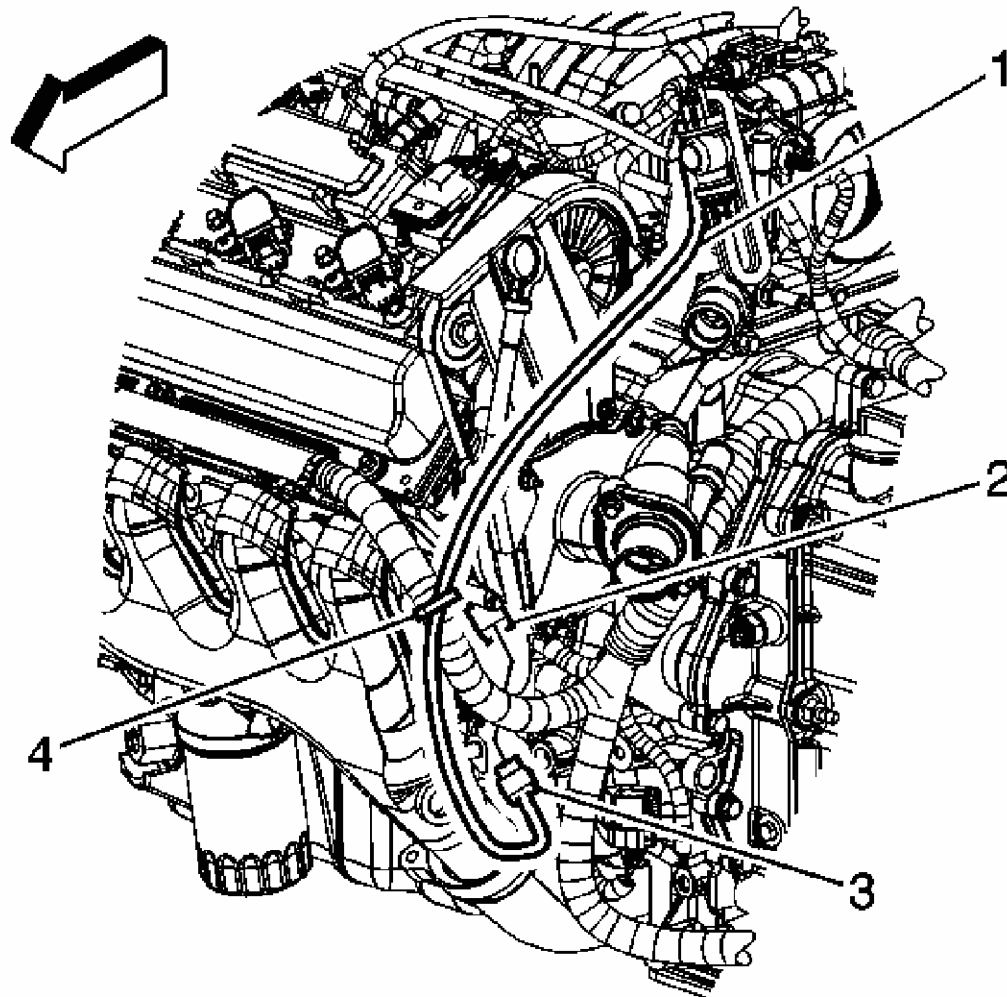
6. Remove the coolant heater cord clips from the fuel rail studs.
7. Cut the coolant heater cord strap at the engine harness.

**Installation Procedure**



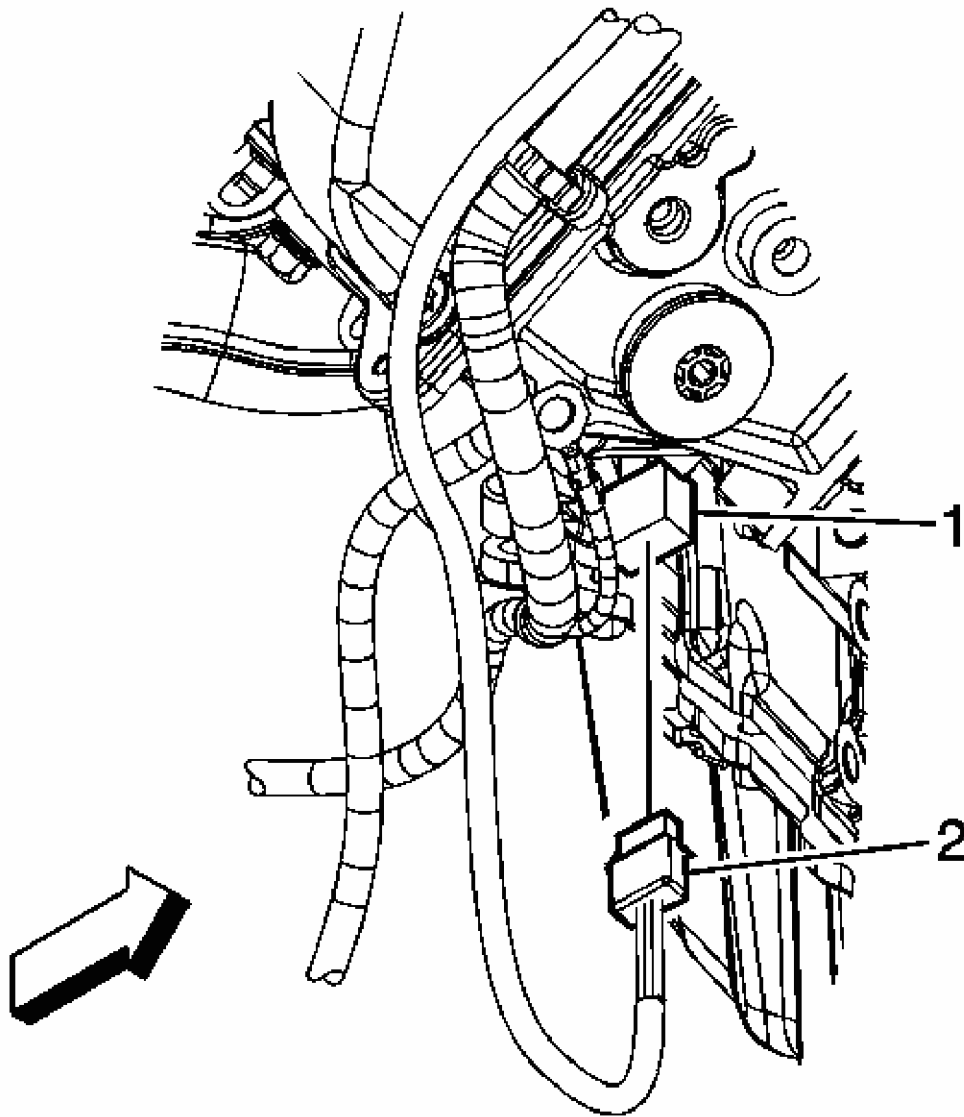
**Fig. 190: Locating Coolant Heater Cord Tabs**  
**Courtesy of GENERAL MOTORS CORP.**

1. Install the coolant heater cord clips to the fuel rail studs.
2. Install a NEW strap attaching the coolant heater cord to the engine harness.



**Fig. 191: Locating Coolant Heater Cord Electrical Connector**  
**Courtesy of GENERAL MOTORS CORP.**

3. Install the coolant heater cord clip (1) to the lift hook bracket.
4. Install a NEW strap attaching the coolant heater cord to the engine harness.
5. Connect the coolant heater cord electrical connector (3) to the left coolant heater electrical connector (2).



**Fig. 192: Identifying Right Coolant Heater Electrical Connector**  
**Courtesy of GENERAL MOTORS CORP.**

6. Connect the coolant heater cord electrical connector (2) to the right coolant heater electrical connector (1).
7. Install the surge tank inlet hose/pipe. Refer to **Radiator Surge Tank Inlet Hose/Pipe Replacement (LD8)**.

## DESCRIPTION AND OPERATION



## **COOLING SYSTEM DESCRIPTION AND OPERATION**

### **Cooling Fan Control - Two Fan System**

The engine cooling fan system consists of 2 puller type electrical cooling fans and 3 fan relays. The relays are arranged in a series parallel (S/P) configuration that allows the engine control module (ECM) to operate both fans together at low or high speeds. The cooling fans and fan relays receive battery positive voltage from the underhood fuse block. The ground path is provided at G104.

During low speed operation, the ECM supplies the ground path for the low speed fan relay through the low speed cooling fan relay control circuit. This energizes the low speed fan relay coil, closes the relay contacts and supplies battery positive voltage from the low fan fuse through the cooling fan motor supply voltage circuit to the left cooling fan. The ground path for the left cooling fan is through the cooling fan S/P relay and the right cooling fan. The result is a series circuit with both fans running at low speed.

During high speed operation the ECM supplies the ground path for the low speed fan relay through the low speed cooling fan relay control circuit. After a 3 second delay, the ECM supplies a ground path for the high speed fan relay and the cooling fan S/P relay through the high speed cooling fan relay control circuit. This energizes the cooling fan S/P relay coil, closes the relay contacts and provides a ground path for the left cooling fan. At the same time, the high speed fan relay coil is energized closing the relay contacts and provides battery positive voltage from the high fan fuse on the cooling fan motor supply voltage circuit, to the right cooling fan. During high speed fan operation, both engine cooling fans have their own ground path. The result is a parallel circuit with both fans running at high speed.

The ECM commands the low speed cooling fans ON under the following conditions:

- Engine coolant temperature exceeds approximately 94.5°C (202°F).
- A/C refrigerant pressure exceeds 1447 kPa (210 psi).
- After the vehicle is shut OFF, if the engine coolant temperature at key-off is greater than 101°C (214°F), the low speed fans will run for a minimum of 60 seconds. After 60 seconds, if the coolant temperature drops below 101°C (214°F), the fans will shut OFF. The fans will automatically shut OFF after 3 minutes, regardless of coolant temperature.

The ECM commands the high speed fans ON under the following conditions:

- Engine coolant temperature exceeds approximately 104.25°C (220°F).
- A/C refrigerant pressure exceeds approximately 1824 kPa (265 psi).
- When certain DTCs set

At idle and very low vehicle speeds the cooling fans are only allowed to increase in speed, if required. This ensures idle stability by preventing the fans from cycling between high and low

speed.

### **Engine Coolant**

Engine coolant is the key element of the heating system. The engine thermostat controls the normal engine operating coolant temperature. Coolant pumped out of the engine block enters the heater core through the inlet heater hose. The air flowing through the HVAC module absorbs the heat of the coolant flowing through the heater core. The coolant then exits the heater core through the heater outlet hose. To prevent the coolant from boiling after the engine is turned OFF an after-boil/heater coolant pump is used.

The HVAC control module will command the after-boil/heater coolant pump ON, when the engine is OFF, under the following conditions:

- The engine is OFF.
- The engine coolant temperature is above 101°C (214°F).

The above coolant flow circuits are designed to show the coolant flow related to the coolant by-pass valve positions only. The thermostat function and thermostat coolant flow paths are not shown.

### **Coolant Warning Messages**

The radio will display the following messages if the following conditions exist in the cooling system.

- Engine hot-A/C OFF will be displayed if coolant temperature is above 117°C (243°F). For imports 115°C (239°F).
- Engine coolant hot-Idle engine will be displayed if coolant temperature is above 118°C (245°F).
- Engine overheated-Stop engine will be displayed if coolant temperature is above 123°C (253°F).

### **Coolant Level Control**

The engine cooling system contains an engine coolant level switch to alert the driver in the event of a low coolant level. When the engine coolant level in the surge tank falls below a certain level, the coolant level switch opens. When the HVAC control module detects an open or a high voltage level on the coolant level indicator control circuit for at least 10 seconds, it will send a class 2 message to the radio requesting display of the low coolant level message. There is approximately a 10 second delay before the HVAC control module sends a class 2 message, to prevent the message from being displayed due to coolant sloshing in the surge tank.

### **Coolant Heater**

The optional engine coolant heater (RPO K05) operates using 110-volt AC external power and is designed to warm the coolant in the engine block area for improved starting in very cold weather 29°C (20°F). The coolant heater helps reduce fuel consumption when a cold engine is warming up. The unit is equipped with a detachable AC power cord. A weather shield on the cord is provided to protect the plug when not in use.

### **Cooling System**

The cooling system maintains an efficient engine operating temperature during all engine speeds and operating conditions. The cooling system removes approximately one-third of the heat produced by the burning of the air-fuel mixture. When the engine is cold, the system cools slowly or not at all, allowing the engine to warm quickly.

### **Cooling Cycle**

The thermostat is located between the radiator outlet and the water pump inlet. At normal operating temperature, coolant is drawn from the radiator outlet and into the water pump inlet by the water pump. In cold conditions, the thermostat bypasses the radiator and the pump draws coolant directly from the engine outlet.

Coolant is then pumped through the water pump outlet and into the engine block. In the engine block, the coolant circulates through the water jackets surrounding the cylinders and absorbs heat.

The coolant is then forced through the cylinder head gasket openings and into the cylinder heads. In the cylinder heads, the coolant flows through the water jackets surrounding the combustion chambers and valve seats, absorbing additional heat.

Coolant is also directed to the throttle body. There the coolant circulates through passages in the casting. During initial start up, the coolant assists in warming the throttle body. During normal operating temperatures, the coolant assists in keeping the throttle body cool.

From the cylinder heads, the coolant is then forced to the engine outlet. Coolant leaves the engine through 4 different routes:

- Through the engine outlet fitting to the radiator. This path is blocked at cold conditions by the thermostat at the engine inlet fitting.
- Through the radiator bypass
- To the heater core for passenger compartment heat and defrost
- Through the vent hose to the surge tank, providing continuous de-aeration of the cooling system

Operation of the cooling system requires proper functioning of all cooling system components. The cooling system consists of the following components:

**Coolant**

The engine coolant is a solution made up of a 50-50 mixture of DEX-COOL and clean drinkable water. The coolant solution carries excess heat away from the engine to the radiator, where the heat is dissipated to the atmosphere.

**Radiator**

The radiator is a heat exchanger, consisting of a core and 2 tanks. The aluminum core is a crossflow tube and fin design. This is a brazed tube with convoluted louvered fin design. Separate tubes and fins are stacked together with a manifold at each end. The entire core assembly is then brazed, forming a homogeneous unified structure. The fins allow for efficient heat transfer from the coolant to the atmosphere. The inlet and outlet tanks are molded with a high temperature, glass reinforced nylon plastic. The tank and gasket is supplied as an assembly with silicone gasket attached to the tank. The tanks are clamped to the core with clinch tabs. The tabs are part of the aluminum header at each end of the core. The radiator also has a drain cock which is located in the bottom of the passenger side tank. The drain cock includes the drain cock and drain cock seal.

The radiator removes heat from the coolant passing through the radiator. The fins on the core absorb heat from the coolant passing through the tubes. Air passing between the fins absorbs heat and cools the coolant.

During vehicle use, the coolant heats and expands. The coolant that is displaced by this expansion flows into the surge tank. As the coolant circulates, air is allowed to exit. Coolant without bubbles absorbs heat much better than coolant with bubbles.

**Pressure Cap**

The pressure cap seals and pressurizes the cooling system. The cap contains a blow off or pressure valve and a vacuum or atmospheric valve. The pressure valve is held against the valve seat by a spring which protects the radiator by relieving pressure exceeding 15 psi. The vacuum valve is held against the valve seat by a spring which permits opening of the valve to relieve vacuum created in the cooling system during cooling. The vacuum, if not relieved, could cause the radiator hoses to collapse.

The pressure cap allows pressure in the cooling system to build up. As the pressure builds, the boiling point of the coolant rises as well. Therefore, the coolant can be safely run at a temperature higher than the boiling point of the coolant at atmospheric pressure. The hotter the coolant is, the faster the heat moves from the radiator to the cooler, passing air. However, if the pressure exceeds the strength of the spring, the pressure valve rises so that the excess pressure can escape. When the engine cools down, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum causes the vacuum valve to open, allowing outside air into the cooling system. This equalizes the pressure in the cooling system with atmospheric pressure, thus preventing the radiator hoses from collapsing.

**Surge Tank**

The surge tank is a plastic tank with a mounted pressure cap. The tank is mounted at a point higher than all other coolant passages. The surge tank provides an air space in the cooling system. The air space allows the coolant to expand and contract. The surge tank also provides a coolant fill point and a central air bleed location.

During vehicle use, the coolant heats and expands. The coolant that is displaced by this expansion flows into the surge tank. As the coolant circulates, air is allowed to exit. This is an advantage to the cooling system, because coolant without bubbles absorbs heat much better than coolant with bubbles.

**Air Baffles and Seals**

The cooling system uses deflectors, air baffles and air seals to increase system cooling. Deflectors are installed under the vehicle which redirect airflow beneath the vehicle to flow through the radiator and increase cooling. Air baffles are also used to direct airflow into the radiator and increase cooling. Air seals prevent air from bypassing the radiator and A/C condenser. Air seals also prevent recirculation of the air for better hot weather cooling and A/C condenser performance.

**Water Pump**

The water pump is a centrifugal vane impeller type pump. The pump consists of a housing and an impeller. The impeller is a flat plate mounted on the pump shaft with a series of flat or curved blades or vanes. When the impeller rotates, the coolant between the vanes is thrown outward by centrifugal force. The impeller shaft is supported by one or more sealed bearings. The sealed bearings never need to be lubricated. Grease cannot leak out, dirt and water cannot get in as long as the seal is not damaged or worn.

The purpose of the water pump is to circulate coolant throughout the cooling system. The water pump is driven by the crankshaft via the drive belt.

**Thermostat**

The thermostat is a coolant flow control component. Its purpose is to regulate the operating temperature of the engine. It utilizes a temperature sensitive wax-pellet element. The element connects to a valve through a piston. When the element is heated, it expands and exerts pressure against a rubber diaphragm. This pressure forces the valve to open. As the element is cooled, it contracts. This contraction allows a spring to push the valve closed.

When the coolant temperature is below the rated thermostat opening temperature, the thermostat valve remains closed. This prevents circulation of the coolant to the radiator and allows the engine to warm up quickly. After the coolant temperature reaches rated thermostat opening temperature, the thermostat valve will open. The coolant is then allowed to circulate

through the thermostat to the radiator where the engine heat is dissipated to the atmosphere. The thermostat also provides a restriction in the cooling system, even after it has opened. This restriction creates a pressure difference which prevents cavitation at the water pump and forces coolant to circulate through the engine block.

#### **Engine Oil Heat Exchanger**

The engine oil heat exchanger is mounted to the top of the engine block, under the intake manifold flange. Oil is pumped through the oil cooler inlet pipe to the heat exchanger, back through the oil cooler outlet pipe and then to the oil passages in the engine for lubrication. The exchanger provides the following 2 functions:

- Engine coolant warms up faster than the engine oil. During cold operation, the coolant warms the oil and provides better flow during cold engine operation.
- After the engine reaches normal operating temperature, the engine oil temperature will exceed the engine coolant temperature. The coolant flowing through the engine oil cooler will absorb heat from the engine oil. Cooling the engine oil extends oil life and helps reduce internal engine wear.

#### **Transmission Oil Cooler - V09**

**NOTE:** The transmission oil cooler system uses quick connect fittings throughout the system. Use a special tool to disconnect these quick connect fittings. Removing the transmission oil cooler lines without this tool will result in damage to the radiator, the transmission and the transmission oil cooler caused by mixing the transmission oil and coolant or due to transmission oil loss.

The transmission oil cooler (TOC) is an oil-to-water heat exchanger located in the radiator end tank and is non-serviceable. The transmission oil temperature is regulated by the temperature of the coolant leaving the radiator. The oil out of the transmission is plumbed through the TOC lines to the radiator end tank cooler then directed back to the transmission.

#### **Transmission Oil Cooler - V03/V92**

**NOTE:** The transmission oil cooler system uses quick connect fittings throughout the system. Use a special tool to disconnect these quick connect fittings. Removing the transmission oil cooler lines without this tool will result in damage to the radiator, the transmission and the transmission oil cooler caused by mixing the transmission oil and coolant or due to transmission oil loss.

The transmission oil cooler (TOC) is an oil-to-air heat exchanger located between the radiator and the A/C condenser. The transmission oil temperature is regulated by the airflow passing

## 2006 Buick Lucerne CXS

2006 ENGINE Engine Cooling - Lucerne

over this heat exchanger. The oil out of the transmission is plumbed through the TOC lines to the cooler then directed back to the transmission. This cooler helps provided additional cooling for performance driving conditions.

### Transmission Oil Cooler Lines

**NOTE:** The transmission oil cooler system uses quick connect fittings throughout the system. Use a special tool to disconnect these quick connect fittings. Removing the transmission oil cooler lines without this tool will result in damage to the radiator, the transmission and the transmission oil cooler caused by mixing the transmission oil and coolant or due to transmission oil loss.

The transmission oil cooler (TOC) lines use quick connect fittings that must be removed using a special tool. The oil out of the transmission is pumped at a high pressure through the TOC lines to the heat exchanger and then directed back to the transmission.

### Power Steering Oil Cooler

Some vehicles are equipped with a power steering oil cooler located either between the radiator and condenser (Heavy Duty) or in front of the engine. This cooler transfers heat from the power steering system to the air passing through the condenser and radiator. The cooler uses constant tension clamps on the hose connections to the cooler.

## SPECIAL TOOLS AND EQUIPMENT

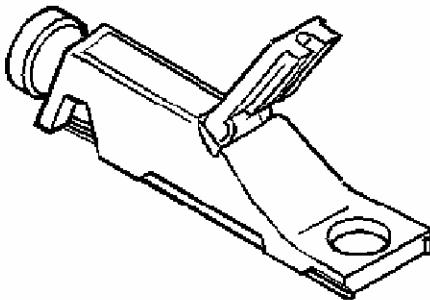
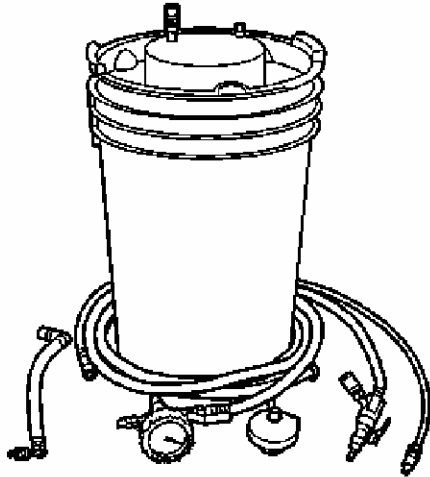
### SPECIAL TOOLS

#### Special Tools

Illustration	Tool Number/Description
	GE-47716 Vac N Fill Coolant Refill Tool

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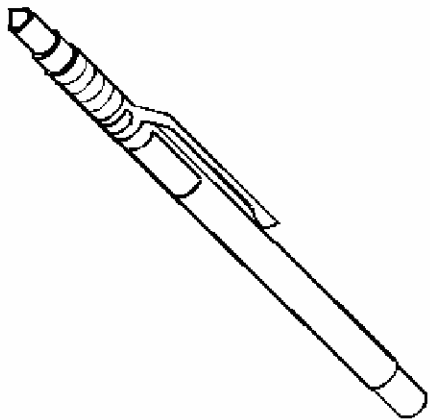
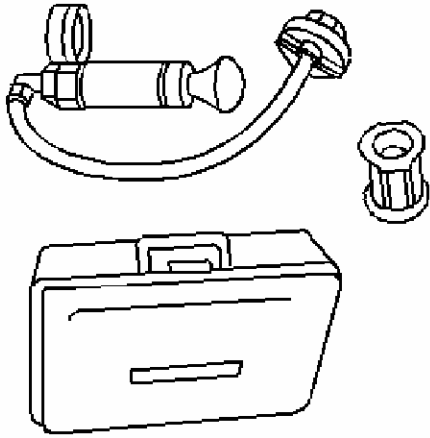
J-23688  
Coolant and Battery Fluid Tester

J-24460-01  
Cooling System Pressure Tester



## 2006 Buick Lucerne CXS

2006 ENGINE Engine Cooling - Lucerne

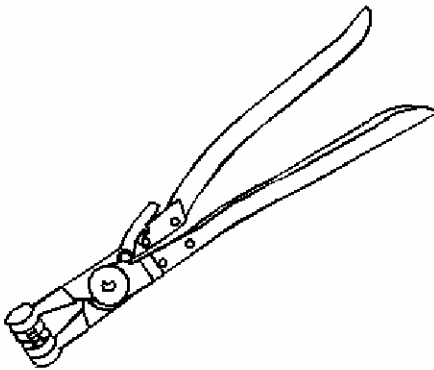
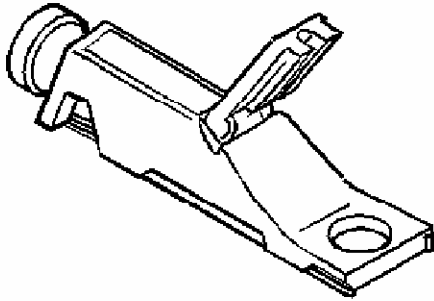


J-24731  
Tempilstick

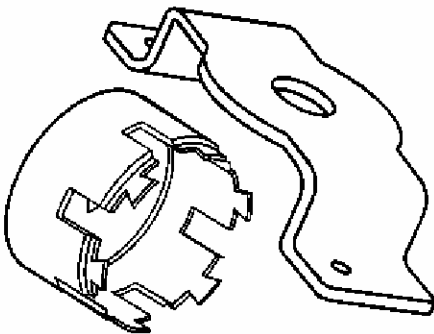
J-26568  
Coolant and Battery Fluid Tester

## 2006 Buick Lucerne CXS

2006 ENGINE Engine Cooling - Lucerne



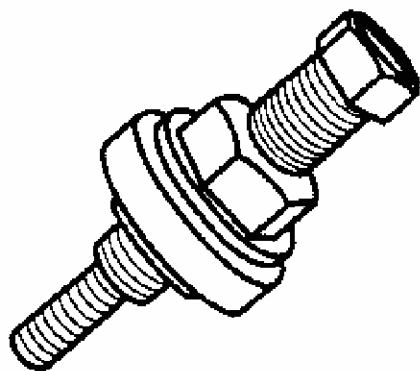
J-38185  
Hose Clamp Pliers



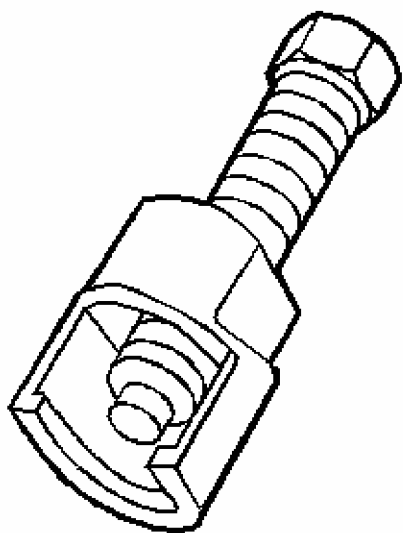
J-38816-A  
Water Pump Remover and Installer

## 2006 Buick Lucerne CXS

2006 ENGINE Engine Cooling - Lucerne



J-38823  
Water Pump Pulley Installer

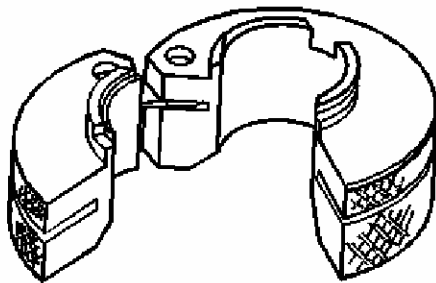
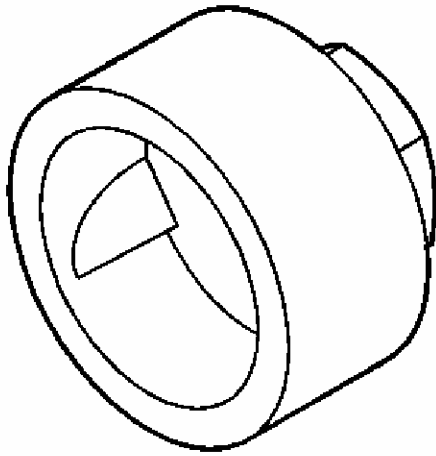


J-38825  
Power Steering and Water Pump Pulley  
Remover

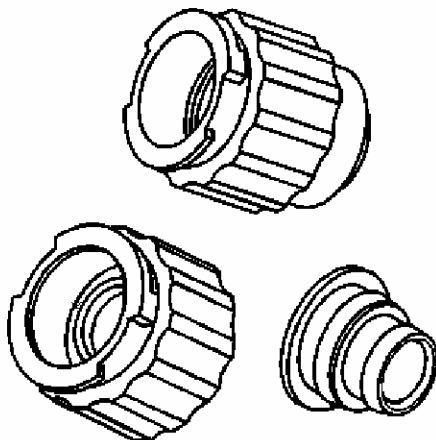
J-39946  
Crankshaft Socket - 4.0L and 4.6L

## 2006 Buick Lucerne CXS

2006 ENGINE Engine Cooling - Lucerne



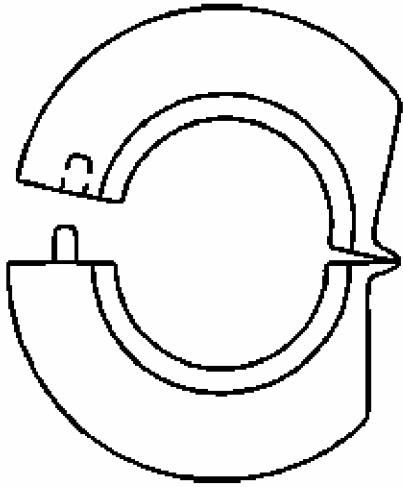
J-41623-B  
Cooler Quick Connect Tool



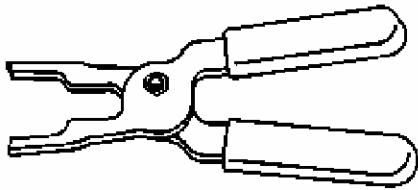
J-42401  
Radiator Cap/Surge Tank Test Adapter

## 2006 Buick Lucerne CXS

2006 ENGINE Engine Cooling - Lucerne



J-43181  
Heater Line Quick Connect Release Tool

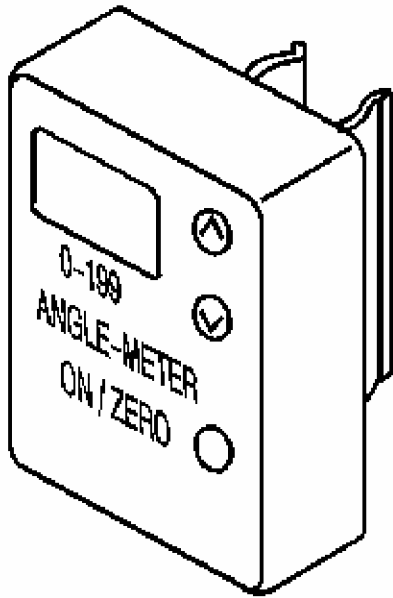


J-43244  
Relay Puller Pliers

J-45059  
Angle Meter

## 2006 Buick Lucerne CXS

2006 ENGINE Engine Cooling - Lucerne



<b>2006 Buick Lucerne CXS</b>
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